AERONAUTICAL ENGINEERING REVIEW

JULY 1944

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SPOTTING JAPS IN THE "WILLIWAWS"

ON May 11, 1943, an American Task Force landed on Attu in the Aleutians to drive out the invading Japs. Drive them out they did after prolonged and bitter action in which bullets and arctic weather took heavy toll. This epic action provided one of the early instances of the effective support of ground troops by carrier-based Naval planes.

The heroic men of Attu will not forget the curse of Aleutian climate. Bitter cold. Dense fog. Snow and rain 250 days in the year. A pilot may take off in perfect weather yet 10 minutes later may be unable to land because fog has blanketed his carrier or his landing field.

The Japs used this natural phenomenon to clever advantage. They placed their men and guns right on the fog line. Result—they could see the attackers but the attackers could not see them. And the wily Japs would shift up and down the mountainous coasts, always keeping under cover of the fog. It's pretty hard to kill a foe you can't even see.

The Japs and the fogs weren't the only foes around Attu. Sleet storms, sudden squalls, freezing clouds that load the wings of a bomber with a ton of ice in less than a minute. And the "williwaws" that can drop a plane 3000 feet in a few seconds.

But the Japs had to be routed from U. S. soil in a hurry . . . dead or alive, preferably dead. That called for bombing in weather as treacherous as the foe.

The Navy knew the Kingfisher was the bird to turn the trick . . . to spot targets and guide our bombing planes where they could drop their deadly eggs in the midst of the foe's strongholds. Because they are Edo Float-equipped, Kingfishers (OS2Us) are known as the planes with "sea-going legs"—because they are able to land on rough water and get off again.

Up went the Kingfishers to serve as spotting planes for the carrier-launched planes assigned to carry out bombing missions. Targets designated by ground units were reported to flights of OS2Us based in the area and relayed through them to the bombing planes. Revetted positions and fox-holes of the enemy came under deadly and accurate strafing and bombing attack. A goodly number of confirmed hits were reported on the designated target areas as well as many "probables".

There aren't any Japs on Attu now. Edo-equipped Kingfishers could climb higher than the Rising Sun. And with the Kuriles only 650 miles away, the gallant crews of the scout planes with the "sea-going legs" can be counted upon to point the way direct to the heart of Japan.

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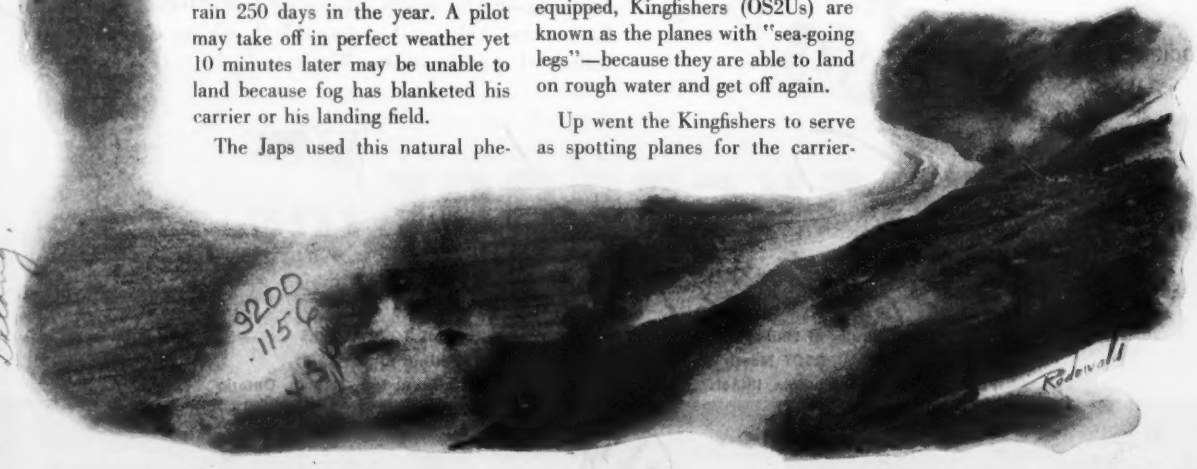

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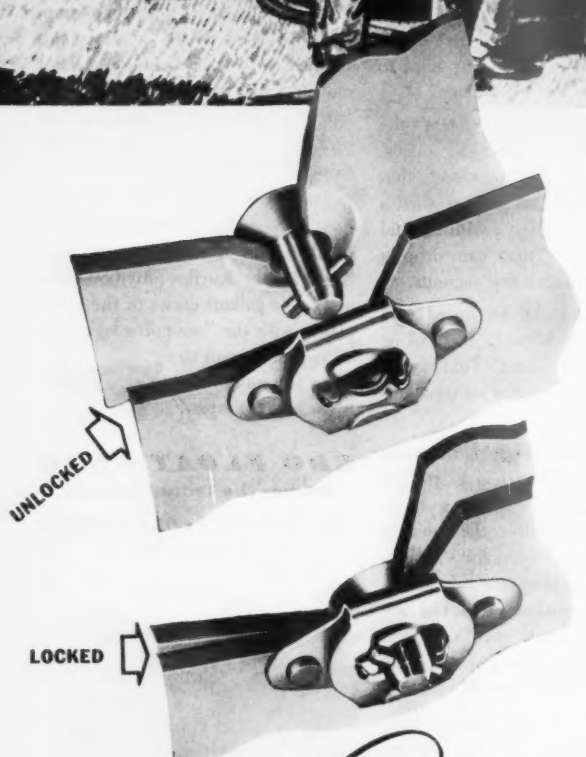

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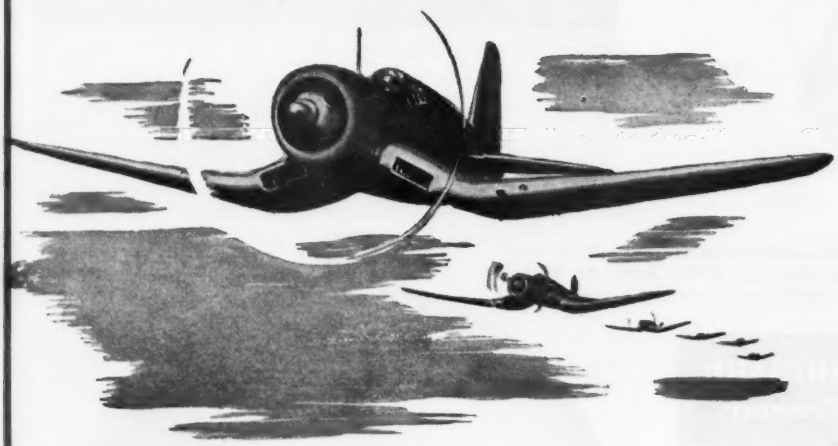

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The Government's Place in the Development of Private Flying

WILLIAM A. M. BURDEN*
Department of Commerce

Introduction

Private flying has been the younger brother of the American aeronautical family. So far it has received only a small part of the engineering attention and dollar investment that have been devoted to military and transport aviation. Partly for this reason and partly because of the technical and economic problems that remain to be overcome before the personal aircraft is a really useful vehicle for large numbers of Americans, the degree to which private flying will expand in the years immediately after the war can be predicted with less confidence than in the case of other forms of commercial aviation. However, there is no question that its potentialities are enormous.

National Importance of Private Flying

Purely from the standpoint of our national economy, the development of a large and healthy industry for the manufacture of personal aircraft, with all the collateral activities of airport operation, servicing, and training, is of great national importance. But the growth of private flying is more than a purely commercial matter. It has important implications for national defense. The number of Americans who learn how to fly as a part of their ordinary civilian existence is an index of our national air strength. It also has a real bearing on the education of our people and their ability to comprehend and solve the problems of the air age.

The importance of a rapid and healthy growth of private flying in this country can, therefore, hardly be overstressed. The industry and we in the Government concerned with private flying have a responsibility to ensure such a growth —not for our own selfish interest but for the interest of the country. In the postwar period the United States is going to need more markets for capital and labor, and it is our responsibility to see that private flying provides as large a market as our combined efforts can create. Not only do we need this outlet for capital and labor, but it is essential to our future welfare that our people become as at home in the air as the people of any other country.

Presented at the National Light Aircraft Meeting, I.A.S., Detroit, April 27–28, 1944.

* Assistant Secretary of Commerce.

Do not for a moment believe that they will become so solely by reasons of our past or present accomplishments. Any lead that we may now have in private flying can be quickly overtaken in other countries and might well be if we rest upon our oars. We should not overlook the fact that in many countries the private airplane will not have serious competition from highly efficient and well-organized rail and highway networks, whereas in this country it must compete with a highly developed ground transportation system. Nor should we overlook the fact that even before the war private flying was subsidized in practically all the major countries except our own, and there is no reason to believe that other countries will not continue this practice in the postwar period.

We are not a great nation solely by reason of our area, our population, or our natural resources. We are healthy by reason of the opportunities we have afforded our citizens for education and the development of their skills. Aerial education and aerial skills will be important in the postwar period, and it is the responsibility of the Government to ensure our people the opportunity to acquire them.

The Personal Airplane

The personal airplane is an essential piece of equipment for such education, and private flying is a school of experience in which aerial skills can be perfected. You who have been entrusted with the development of this equipment and this school of experience therefore share with us in Government the responsibility to the country of ensuring that the equipment is as good and the school as large as we can make them.

Since it is our joint responsibility, neither of us will have measured up to that responsibility if we have not given full cooperation to the other. We are partners in a great enterprise, and we can do the job better if we determine in advance in which fields industry and in which fields Government will be the senior partner.

The problem of developing private flying is a many-sided one, but there is, or should be, no question of what comes first. The growth of the personal-aircraft industry depends primarily on how rapidly and to what extent the usefulness of the personal airplane to the average American can be improved.

Increased utility depends above all on two things. (1) Improvement in aircraft and instrument design which will make the private aircraft easier, safer and more economical to fly, and more independent of weather. To quote a well-known designer, practically everything desirable in the private airplane that does not come under the heading of safety comes under the heading of low cost. (2) The expansion of our airport system so that the private pilot can get where he wants to go.

Research and Design

In the field of research and design the relative responsibilities of the Government and industry are clear. The responsibility for the development, construction, and sale of personal aircraft should be wholly in the hands of private industry. The airplane manufacturers believe that they have, or can secure, the necessary capital for such development. Given this one essential, the most rapid possible progress will be assured by individual initiative acting under the spur of competition.

In the field of basic research, which provides the raw material for design, Government can, I believe, play a useful and important role. The wind tunnels and research facilities of the National Advisory Committee for Aeronautics, now entirely engaged in solving urgent problems of military aircraft design, have been greatly expanded as a result of the war, and with the coming of peace can be devoted more completely to basic research that will be

What will this wartime development do for you?

Alcoa special rolled shapes having cross sections as large as thirty square inches, and weighing 1,200 pounds per piece, have saved many a man-hour in the assembly of America's bombing planes. Actual designs are a military secret, but they approximate what you see here.

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Perhaps those wartime projects now on your drawing board can employ Alcoa Aluminum rolled structural shapes to save man power and materials. And how about your postwar designs? Alcoa engineers will gladly help you determine the facts. ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

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important to all branches of aviation. They should and will be made available on an increasing scale for research on basic problems that are of special and peculiar importance to the design of private aircraft—I refer to such matters as nonspinning characteristics, noise reduction, and propeller design. The gap between military and transport flying and private flying has widened. I consider it definitely in the interest of the country that research projects that have major significance primarily for private flying be vigorously prosecuted.

Landing Facilities

The construction of a comprehensive and intelligently planned system of landing facilities is as essential to the growth of private flying as the development of our system of roads was to the expansion of the passenger automobile industry. In a survey conducted by the C.A.A. among individuals who had given up flying, inaccessibility of airports ranked second only to items of cost among the reasons advanced for their abandoning their airplanes. Many communities have no landing field of any description, and in many of the larger towns private and transport flying are jumbled together on a single field which, however well located from the transport point of view, is often inaccessible to the residential districts.

The landing area requirements of the private flier are far simpler than those of the scheduled air line. Small L- or T-shaped fields with 1,800- to 2,500-ft. runways will suffice, but it is essential that they be located close to the residential and business districts of the town. Because of their small size they can be.

Financial Assistance

In the matter of financing these landing areas, government support—Federal, State, and local—will probably carry an important part of the load, but individual initiative is also extremely necessary.

Federal assistance for the construction of airfields for the private flier is, in my opinion, advisable and justifiable, and I hope that Congress will take the same view when it considers the matter of legislation for a long-term program of civil airport construction.

The C.A.A. national plan, which will probably be completed in the next 2 months, calls for the construction of nearly 3,000 new airports, of which little more than 100 will be larger than Class II, and the enlargement of approximately 600. This is exclusive of some of the metropolitan areas, plans for which are not complete but will be brought into subsequent revisions. The plan, when completed, will call for increasing the number of Class I and II airports from roughly 2,000 to 4,600; Class III airports, from 430 to 600; and Class IV airports and larger, from about 600 to just over 700 — a total of practically 6,000 airports or twice the number we now have.

If the country is to have a network of landing fields sufficiently extensive and convenient to permit the kind of expansion in private flying we are all looking for, private initiative will have to play an important role. Municipalities must recognize that local airports for the aircraft owned by their citizens are as much a municipal responsibility as the construction of city streets. Groups of interested private citizens must advocate and promote the construction of local airports much as the various good roads associations pushed for the construction of better highways in the early days of the automobile. However, these campaigns must be conducted with judgment, as well as with enthusiasm, for, if unwarranted rosy prophecies are made as to the future of private flying, the cause will suffer from the inevitable disillusionment and reaction as it did after the 1929 bubble.

At this point I should like to say that in many respects the State of Michigan has set the pace with its progressive and intelligent airport planning and construction. The State Board of Aeronautics has recently completed a pamphlet report on Michigan's existing and proposed airports which, in its comprehensiveness and content, is altogether exemplary. Inasmuch as they cooperated so closely with the district and regional personnel of C.A.A. that practically all of the report's recommendations have been incorporated in our National Plan, I may be prejudiced in praising it so highly. Seriously, however, the field facilities and personnel of C.A.A. are there to be used and the more they are made use of the better for all concerned with aviation.

National Parks

The Federal Government should, I believe, provide landing facilities at its national parks and forests, and we have recently arranged with the Parks and the Forest Services to cooperate in the surveying of sites and drawing up of plans for the development of airports adjacent to the entrances of the areas controlled by these two services.

Aerial Marking

Aerial marking for the private pilot is just as much a Government function as is the establishment of airways. Considerable progress had been made in such marking prior to the war. My personal belief is that the country should be sufficiently well marked so that a private pilot can depend wholly upon the markers for his navigation under contact conditions. For this I favor marking in terms of latitude and longitude. With such a system the markings themselves would immediately locate the pilot in distance and direction from any points whose latitude and longitude he knew without reference to maps.

Regulation of Private Flying

I have left discussion of regulation of private flying to third place, although I know it is probably uppermost in your minds when considering the Government's place in the development of private flying. I am wholly in agreement with the statement of the Safety Bureau of the Civil Aeronautics Board accompanying the proposed changes in air traffic regulations: "The purpose of the regulations should be to protect the lives and property of the public from careless flying rather than to protect the pilot from his own carelessness."

In a survey to which I have previously referred, many interested in the private airplane field expressed the belief that continuation of a strict regulatory policy with respect to private flying would seriously interfere with the expansion of private flying. A survey of past private owners supported this contention. In this survey excessive regulation appeared as a significant item in the reasons given for discontinuance of ownership.

As you undoubtedly know, the Civil Aeronautics Board, which writes the regulations, has already taken preliminary steps looking toward material reduction in the regulation of the private pilot. In considering these proposed changes in regulations I would suggest that you keep in mind that the body of regulation cannot be reduced while the individual regulations that make up that body are retained. All too frequently individuals have insisted that the regulations should be reduced but at the same time have opposed the elimination of individual regulations that would be required to accomplish any such reduction.

Education

Education has long been a function of Government in this country and educational opportunities have thereby been made available to the many instead of the few. I believe it is our responsibility in Government to insure that education in aviation is also made available to all who seek it and not limited to the few who can afford to go to special schools to acquire it. This education should extend all the way from the grade schools to the universities. This is in itself no small task and of no small importance to the growth of private flying. It involves modernizing the texts of many subjects to include therein the impact of aviation on these subjects. Geography might be cited as the outstanding example of a subject that must be completely reviewed in the light of aerial transportation. It involves making elementary ground-school and flight instruction available in our schools. Ground instruction is already well on its way to becoming a part of our school curriculum through the C.A.A. Preflight Aeronautical Program, which is already established in 14,000 high schools. This program should be intensified and expanded.

Flight Instruction

The provision of flight instruction in our schools and colleges is, I believe, a most powerful tool for ensuring American supremacy in aviation. It is essential, both for our national security

(*Continued on page 27*)

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Traffic Control Problems for Future Airports

M. G. BEARD*

American Airlines, Inc.

Introduction

Air-line traffic, prior to Pearl Harbor, was fast reaching the saturation point at LaGuardia Field. On December 1, 1941, there were 248 scheduled departures and arrivals at LaGuardia, not including extra sections. The peak period of the day was from 5:30 to 6:30 p.m. with 40 plane movements during the hour. Shortly after 5:00 p.m., it was not unusual to see from twelve to 15 planes waiting in line for their respective turns to take off, nor was it unusual for an airplane approaching the LaGuardia range control to be assigned No. 14 in position for landing. Whenever ceilings went below 1,000 ft. with visibility below 3 miles and it became necessary to institute low approach procedures, traffic delay and tie-up would frequently detain arrivals during this hour from 3 to 4 hours. Under these conditions it was necessary to hold airplanes on the ground at the last airport of departure to prevent undue congestion in stacking of airplanes over the holding points on traffic lanes feeding into the LaGuardia range control.

Through the cooperative efforts of the air lines operating out of LaGuardia, the Civil Aeronautics Administration Air Traffic Control, and the LaGuardia tower operators, a system was worked out whereby it was hoped that planes could be landed at approximately 4-min. intervals whenever low approach procedures were necessary. This process was tried out under fair weather conditions and worked quite well as long as the landing direction was straight in from the range station. The trials also indicated that all pilots flying into the area would necessarily have to be well-trained in the operations of the procedure before it could be used under actual instrument approach conditions when ceilings and visibilities were at a minimum.

The sudden reduction in scheduled operating airplanes shortly after Pearl Harbor relieved the congestion considerably. The traffic problem will be increasingly acute again when the air lines are allowed to procure additional transport planes for schedule operation.

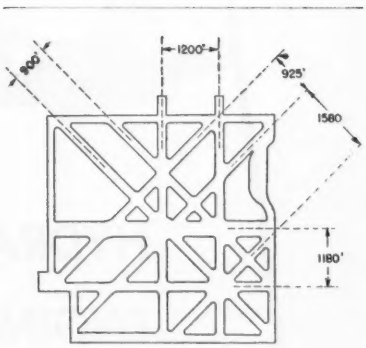

Fig. 1.

The Parallel Runway System

Many of the large cities throughout the country are planning airports, to be constructed immediately or in the near future, which will be capable of handling volumes of traffic several times greater than existed before the war. The first and most obvious method of increasing runway facilities to handle the augmented volume is the parallel runway system whereby airplanes can be landed and taken off simultaneously on the same airport. Fig. 1 shows the layout of a typical parallel runway system. Under fair weather conditions, the parallel runway system effectively doubles the capacity of any airport. However, when weather conditions approach the minimum (navigational aids not yet having progressed to the extent where traffic lanes in the close proximity of the airport are clearly defined), it becomes necessary, even

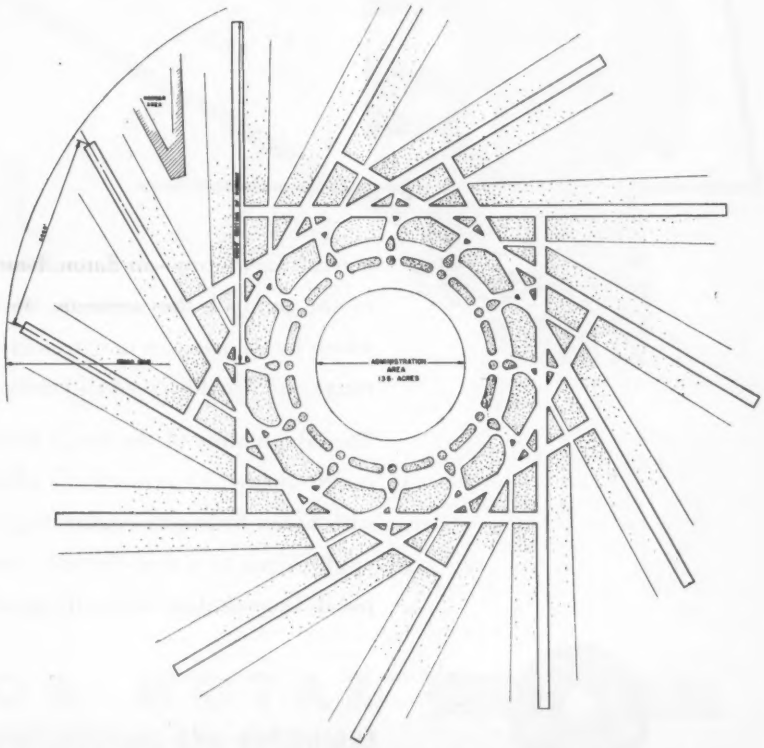

Fig. 2. Area inside the 13,800-diameter circle equals about 3,450 acres.

Presented at the Air Transport Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Director of Flight Engineering.

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ROTOR VANE CONTROL
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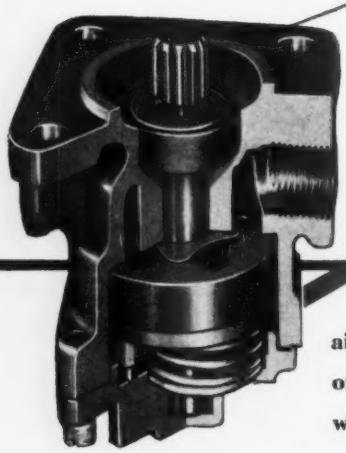

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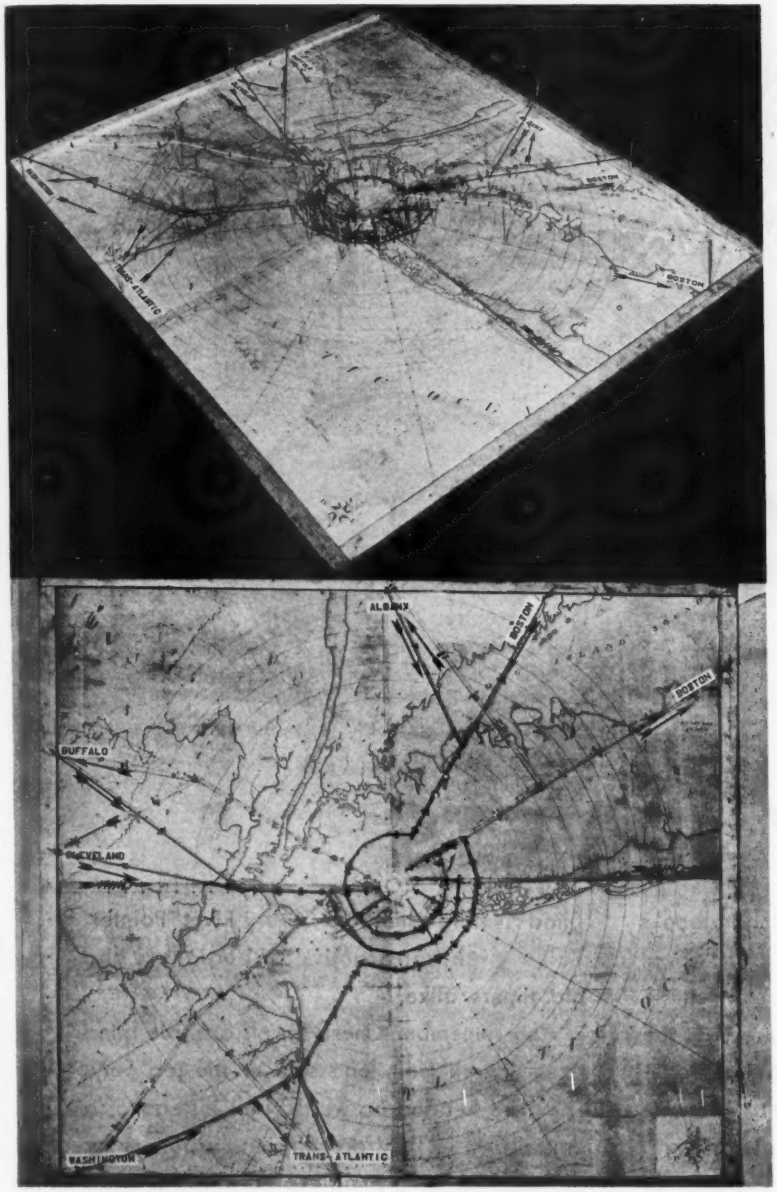


FIG. 3. Three-dimensional study of circular traffic pattern about tangential plan airport for Idlewild.

on the parallel runway airport, to hold departing planes on the ground until the exact locations of planes between the range station and the airport are definitely known. Thus, in instrument approach weather, the traffic capacity of this layout is reduced almost to that of the single runway airport.

At best, the parallel runway system can no more than double the capacity of an airport equipped with a single runway in each direction. Adding additional parallel runways makes for little increase in the actual traffic capacity of the airport under clear weather conditions, since problems of additional taxiing and taxiing across operating runways rapidly encounter diminishing traffic returns for the added runways. The close proximities of planes approaching and taking off on instruments make the use of more than one runway for each operation unfeasible on a multiple parallel airport layout.

THE TANGENTIAL RUNWAY SYSTEM

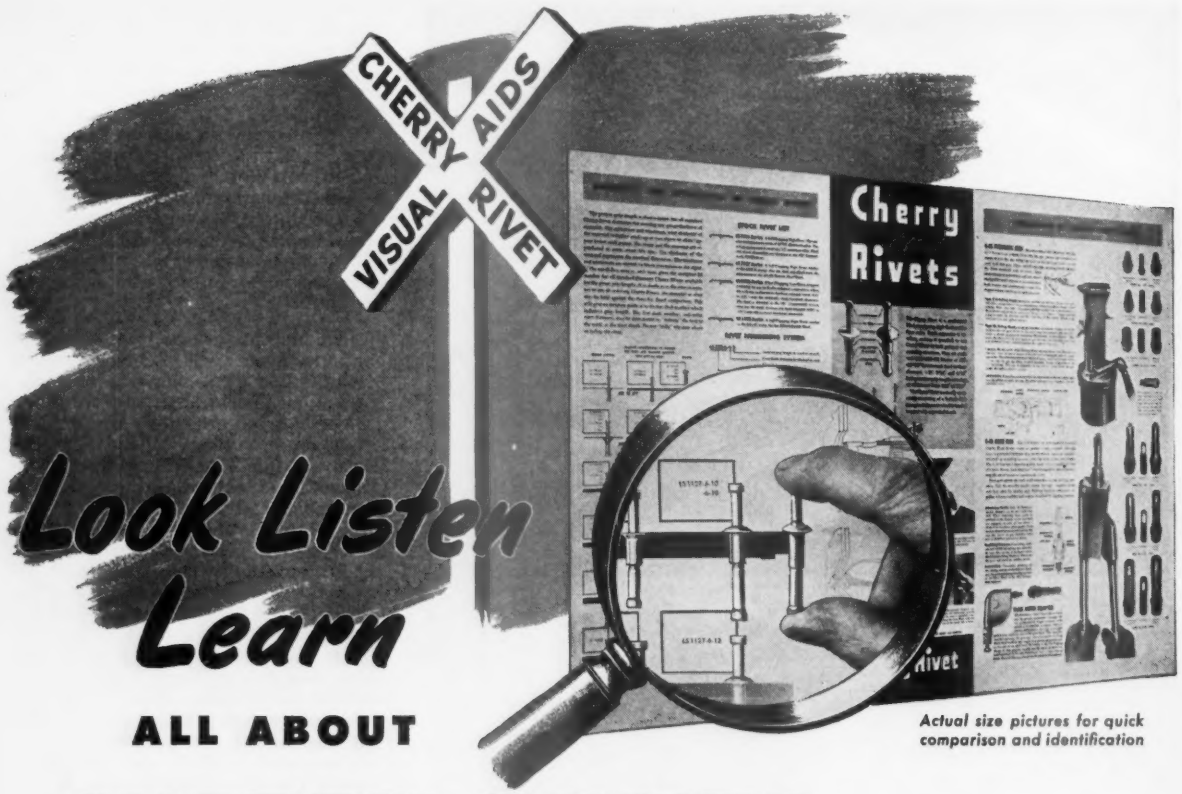
The tangential runway system (Fig. 2) offers the most logical solution yet devised for the safe lateral separation of multiple runway approach and take-off lanes about a large central airport. It provides minimum taxiing distances between the terminal and landing and take-off runways. The diverging runways make it possible to gain any desired horizontal separation between adjacent glide paths, allowing safe clearance between planes simultaneously turning into approach glide paths, and affording pilots time to bracket the approach beam and establish their course before the converging glide paths are reduced in separation below safety allowances. The suggested plan for a tangential runway airport having twelve 6,000-ft. runways allows a 3,440-ft. separation at the landing end of the runways to provide adequate protection for emergencies, such as off-course misses of the runway and consequent proceeding around for a second trial.

The tangential runway system for an airport layout will provide ground facilities for great increases of traffic in and out of central airports whenever the science of air traffic control and direction has been adequately developed. Fig. 2 shows a twelve-runway tangential layout, using three runways for landing and three for take-off, which will be capable of handling a theoretical total of 360 operations an hour, with airplanes spaced at 1-min. intervals for each runway and traffic lane, provided the details of the traffic control and developments in radar and other radio aids have advanced sufficiently to handle such concentrations of traffic safely. Experience indicates that emergencies and time tolerances for weather and piloting factors, under instrument conditions, may reduce the theoretical capacity by 20 to 25 per cent. Therefore, in order to obtain an airport for the future capable of handling 250 operations an hour under all weather conditions, the layout must provide a theoretical capacity of 360 operations an hour.

INSTRUMENT LANDINGS

Jimmy Doolittle made his first instrument landing at Mitchel Field on September 24, 1929. Since that date slow progress has been made in developing suitable and reliable instrument landing devices, although several satisfactory systems have been developed in recent years for safely landing an airplane flying on instruments under conditions of low visibility and ceiling. The first use the air lines will make of these systems for instrument landings will be to lower the minimums of visibility and ceiling in stages as the ability of all pilots in using the systems approaches perfection.

Directly following the end of the war, the air lines will have available a well-established network of radio ranges for en route radio navigation. There will also be available a suitable system for runway approaches under low ceiling and visibility that can be rapidly installed on each runway of all central airports serving the air lines. The radio-range system now in existence is adequate, with few modifications, for directional control of air traffic. However, the existing method of space control must be improved and drastically modified to handle adequately the anticipated increase in traffic volume.



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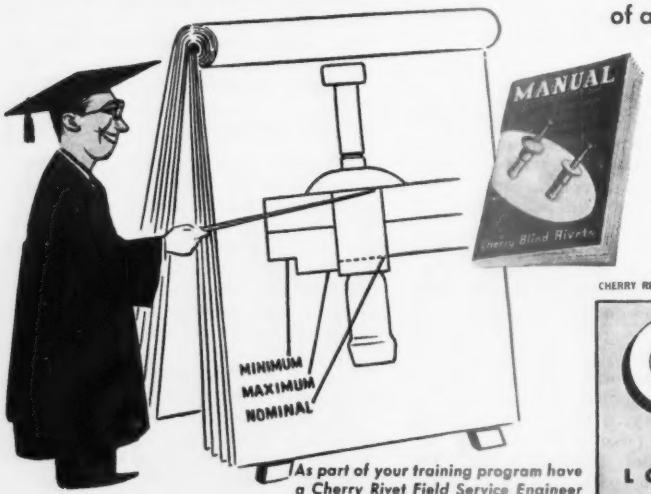

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Fig 4.

There is also a "missing link" that must be supplied between the radio-range station and the approach landing beam to provide smooth traffic flow. Because of this gap there has been no well-devised system for traffic direction. The entire plan of handling increased traffic volume for any airport, therefore, collapses as soon as ceilings and visibilities become critical. Until adequate means have been developed for localizing and controlling traffic between the range station and the approach beam so that the airplane's path can be accurately prescribed and maintained throughout this area, traffic congestion and tie-up will be as bad as that existing before the war whenever instrument approach conditions prevail. The solution to this problem will undoubtedly be delayed until certain developments, which are still military secrets, can be divulged and applied to working out the various details. This "missing link" in the system of controlling traffic between radio range and the runway glide path has been well recognized by the air lines, and various agencies are now working toward the solution of this problem.

Air Traffic Control

The use of multiple runways, so that simultaneous landings and take-offs can be made on more than one runway at closely spaced intervals of time, creates a vastly greater problem in air traffic control than has heretofore existed. The system must work with continuous traffic flow under all weather conditions possible of negotiation with the present art of flying. The system must allow sufficient slack, in the form of circling areas, in order to maintain a smoothly flowing traffic pattern whenever delays occur ahead at any point along the route. It is obviously impossible to halt traffic in the air as is done on all other forms of ground and water transportation.

In studying the traffic control problem for the tangential system of runways, a three-dimensional model of the airport was devised, with various colored threads suspended from pegs in the board to denote elevations and flight paths for the various runways of landing and taking off. Such a model is shown in Fig. 3. This particular layout brings traffic in from the control points, which are the radio-range stations on main arteries feeding into the airport control area. From each range station, traffic moves into a designated circling path at a prescribed altitude. The innermost traffic circle of this model is at 5.8 miles radius from the center of the airport. Lateral separation between the concentric flight paths is 2 miles. Each traffic artery feeding into the control area is assigned a landing runway, depending upon the existing wind direction. Assignment of landing runways must be made by automatic signal devices before the airplane crosses the terminal range station and enters the airport control area. Each runway must have its assigned frequency for glide path localizer transmitter. Each airplane permitted to enter this area must be equipped with radio having all of the runway frequencies.

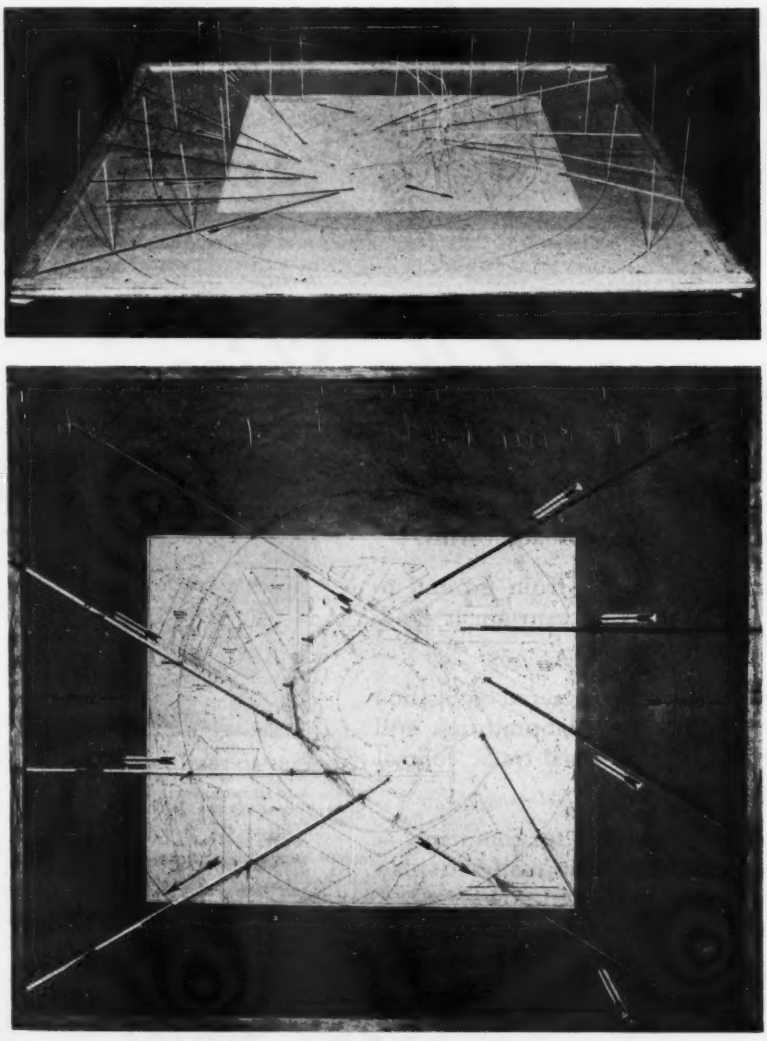

Fig. 4. Three-dimensional study of emergency procedures on tangential plan airport.

Lateral and Vertical Separation

Both lateral and vertical separation may be used in such a system, although vertical separation is restricted because of the limitations of the climbing out paths of the airplanes taking off from the central airport. In the system shown in Fig. 3, the innermost circle is assigned 750 ft. altitude and each adjacent circle is 250 ft. higher, so that departing airplanes can climb above the circling approach paths without interference with traffic on these approach paths. The radius of the innermost approach circle is determined by the safety spread considered necessary between landing glide paths at the point of turn in from the approach circle to allow for lateral deviation from the approach beam during the initial bracketing oscillations made by the plane and also by the allowable angle of the glide path. The minimum circling radius of 5.8 miles gives a 3-mile separation between the centers of the glide paths as illustrated in Fig. 5. With perfection in using the landing systems, it is anticipated that it will be possible to reduce the radius of circling considerably, thereby reducing the flying time between the terminal range station and the landing. The reduction of the circling radius will be based on the experience factor denoting the ability of the average pilot to handle this or any other improved system of instrument landing.

Minimum Circling Radii

Minimum circling radii must also be governed by required altitudes for circling which are dependent upon terrain and obstructions in the control area. This, in conjunction with maximum landing glide path angles, will form the minimum circling radius limit possible for any given airport. The required circling altitude must then be compared with the climbing performance of all airplanes using this airport so that these airplanes will be able to clear all circling approach paths by an adequately safe margin, due consideration being given to emergencies of engine failure directly after take-off or during any part of the initial climb

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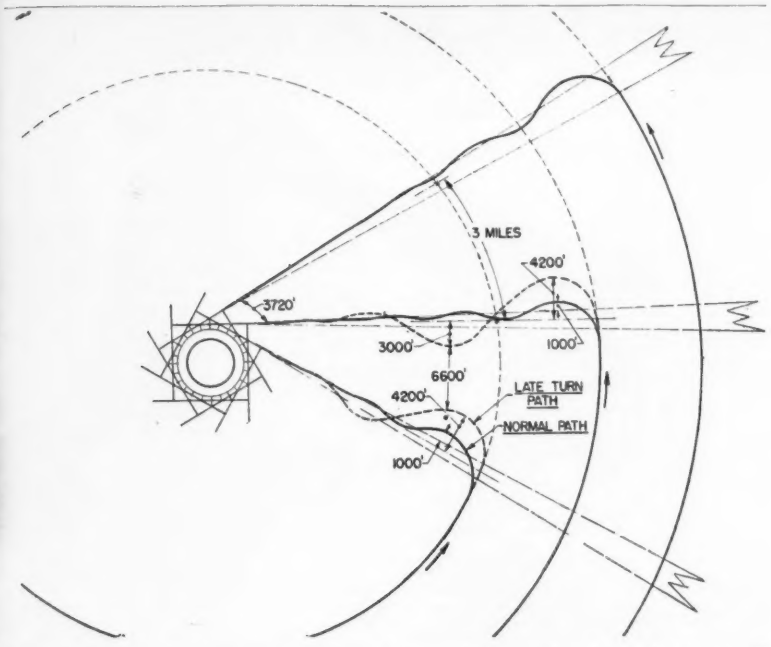

FIG. 5. Layout showing approach procedures and separations from circular traffic pattern about tangential airport.

prior to attaining the altitude for approach circling. The plan, as devised for the pattern shown in Fig. 3, gives a 500-ft. separation between the climbing path and the closest circling path for approaching airplanes. The climbing path begins after a 2,000-ft. take-off run. From point of take-off to 1 mile from the end of the runway, a rate of climb of 310 ft. per min. at 120 m.p.h. is assumed. Between 1- to 6-mile circles, a rate of climb of 580 ft. per min. at 140 m.p.h. is assumed. The glide-path angle should be standardized to a constant value for all airports so that approach speeds, powers, and technique on instrument approaches will be the same throughout the continent, thereby obtaining a standard procedure to be followed at all times by all pilots in fair or foul weather. Present approach glide-path angles are between 2° and 3°. Development of more efficient wing flaps may permit steeper angles in the future.

AUTOMATIC SYSTEM OF TRAFFIC CONTROL

The airport control area for a twelve-runway airport, using three runways for landing and three for take-off and with traffic spaced at 1-min. intervals, may have as many as 70 planes to handle at one time within the area of a 10-mile radius. Two-way voice communication would be hopelessly congested with the available frequencies. An automatic system of traffic control having the following basic features is a possible solution:

(1) A central traffic control system having automatic indication of the position of each plane in the control area as well as individual plane identification.

(2) The central control to have all transmitting facilities necessary to set up air tracks for all planes leaving and entering the area and to transmit take-off and landing runway assignments and frequencies to all planes in the control area. This traffic information to be automatically received and indicated in the plane.

(3) All planes allowed into the control area to have automatic receiving and indicating equipment and panels to show all necessary data, such as traffic lane frequency, landing and take-off runway, and prescribed altitude; also visual indication of traffic lane to be followed and visual portrayal of landing runway outline. Assignments to be made and received by plane before entering the control area.

(4) All planes to be equipped with obstruction indication devices scanning 180° ahead and giving continuous indication of this area. Scanning of the 180° to the rear may be done intermittently if weight-saving and simplification of apparatus are gained by this reduction.

(5) All planes to have necessary radio for the instrument landing system used at the airport, in addition to the panel indication of item (3).

(6) Absolute altimeter and automatic direction finder should function in conjunction with other radio to provide distance indication and direction from the centrally located traffic control transmitter antenna, thus providing a double check on circling path and landing glide path indicators.

(7) Two-way radio communication to be used in emergencies only when a plane loses signal, gets out of line, or is having difficulty.

EMERGENCY PROCEDURES

The establishment of consistent traffic procedures with central control within the traffic area would eliminate many of the minor difficulties repeatedly experienced under present low approach methods. Nevertheless, analysis of any contemplated traffic system must take into consideration all the stoppages and difficulties so far experienced and must include procedures for adequately handling them. The most frequently occurring emergency landing is that of overshooting the runway from too high or too fast an approach. The (curving) thread in the model, Fig. 4, indicates a possible procedure in case of overshooting the runway by a plane landing on the right-hand runway of the three prescribed for landings. A plane overshooting this runway could proceed directly ahead in a rated power climb and clear the flight paths of all planes taking off. Greater clearance could be obtained, however, by having this plane circle to the left and cross over the take-off runways rather than proceed straight ahead over the climbing paths of airplanes taking off. The emergency path shown is laid out for the rated power climb of a DC-4 at full gross weight. It is assumed that the pilot is aware that he must proceed around when half-way down the 6,000-ft. runway and that the plane has a speed of 90 m.p.h. The radius of turn is 1 mile with an 11° bank at 140 m.p.h. indicated air speed. The plane will clear the first take-off runway by 550 ft.

The other two runways are not critical since the plane will have climbed to a higher altitude as each runway is crossed. Since the circling pattern is at an adequate distance from the center of the field, it will be possible to bring this plane around within the general landing circling pattern and, if necessary, keep this plane circling on a 2-mile radius around the airport until such time as an opening in the landing pattern can be created to bring the plane in on one of the three available landing runways or onto the runway assigned for emergency landings. The middle and left-hand landing runways do not create a serious problem for the overshooting emergency, as the planes taking off and proceeding on around from these two runways can progress nearly straight ahead in a climb until such time as they have attained a suitable altitude and can be directed into the general landing circling pattern or until they can be worked around on an inner circling path and landed on the emergency landing runway.

Blocked Runway

The emergency of a blocked runway from a landing accident is always present. If traffic is proceeding at maximum density of 1-min. spacing for all three landing runways, the planes already on the approach glide path must proceed ahead onto the central emergency circling path to be directed into the landing traffic later, or they

(*Continued on page 25*)

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High-Altitude Testing Chamber

FRED A. HEDDLESON*

Westinghouse Electric & Manufacturing Company

DURING THE PAST FEW YEARS, the operation of aircraft at increasingly higher altitudes has brought with it a multitude of problems, one of which is the efficient operation of the aircraft electrical system.

Investigation of the satisfactory rupturing of arcs, circuit-breaking, brush wear, insulation, and maximum ratings of equipment under altitude conditions has prompted the installation of laboratory equipment in which the operation of electrical equipment could be examined under the severe conditions found in the stratosphere. A schematic layout of the laboratory is shown in Fig. 1 and an installation view in Fig. 2.

The high-altitude testing apparatus simulates conditions under which electrical equipment would be expected to operate in aircraft. Some equipment isolated from all local sources of heat must operate in ambients of −55°C., while some other equipment operates in much higher ambients (close to the aircraft engine), possibly being blast-cooled with air at −55°C. taken in through an air scoop.

To simulate either of the conditions, the high-altitude chamber has been equipped with two cooling systems. One set of cooling coils maintains the desired temperature inside the chamber; the other set of coils reduces the temperature of the air used for blast cooling. All air used for this purpose is exhausted into the atmosphere from the vacuum pump. No air is recirculated, thus guarding against contaminated air.

* Special Development Engineer.

ALTITUDE EQUIPMENT

The testing chamber is constructed of a welded steel shell properly braced with rolled structural members to prevent distortion when subjected to atmospheric pressure. The inside working space of the chamber is 30 in. wide, 30 in. high, and 36 in. deep. Fiberboard insulation 6 in. thick, waterproofed by a coating of special cement, surrounds the steel shell. The outside of the chamber is covered with pressed fiberboard.

The open end of the chamber is fitted with a full-sized door. Mounted in the door is an 18- by 20-in. four-panel glass window through which continuous inspection can be made.

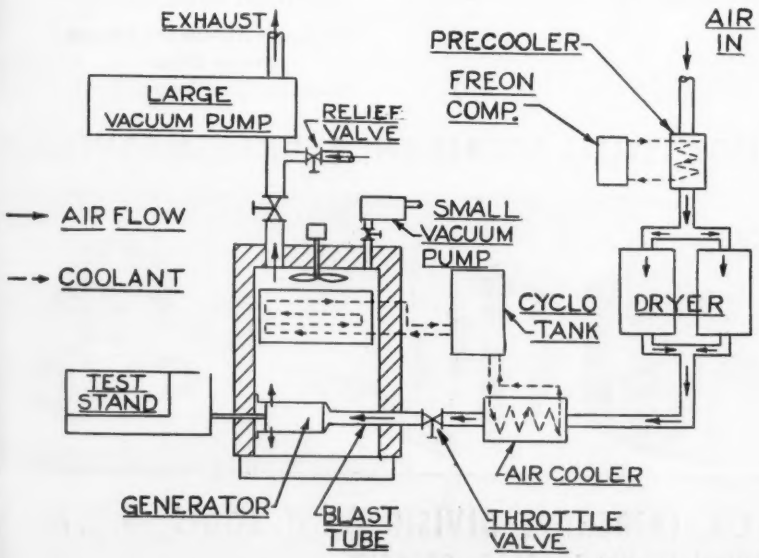

FIG. 1. Diagram of a system layout.

The cooling coils for control of chamber temperatures are mounted in the rear of the chamber, together with a fan that circulates air over the coils and through the testing space. The fan is driven by a $^3/_4$-hp. motor through a special sealed shaft passing through the wall of the chamber.

Electric heaters that will not arc over in a vacuum have been installed just behind the cooling coils to assist in fast temperature changes required for simulating certain flight patterns. These heaters are such that the creepage distances have been increased and the space between terminals made great enough to prevent flashover.

A special pressure-sealed shaft for driving electrical equipment during tests passes through the wall of the chamber. The shaft extends into a standard Air Corps generator mounting bracket attached to the inside wall of the chamber. Generators or other equipment can be mounted on the bracket and driven under load by a standard Air Corps test stand located outside the pressure chamber.

A small rotary vacuum pump with capacity limited to evacuation of the testing space is mounted on top of the chamber. This pump will evacuate the chamber to 50,000 ft. altitude in about 30 sec. The altitude or vacuum regulation is controlled by a safety or poppet-type valve.

A liquid similar to kerosene is used as a coolant. It is chilled by dry ice in the cyclo tank, which is a copper-lined, heavily insulated container from which the coolant is pumped to the cooling coils. The pump is controlled automatically by either the temperature of the air inside the chamber or the temperature of the air entering through the blast tube. Automatic control is possible for only one system at a time. When one system uses automatic control, manual valve setting can be used for control of the other system.

The air cooler is a reinforced sheet-metal housing containing several passages of finned-tube cooling coils. The housing is open at each end to facilitate airflow through the unit. Coolant from the cyclo tank is pumped through the coils and chills the dry air from the drying tower before it enters the chamber.

Dew points measured at high altitudes indicate that air in the stratosphere is extremely dry, having dew points several degrees below the free air temperature. To simulate this condition, a dehumidifier was installed to dry the entering air. Drying is accomplished by passing the air over activated alumina. The capacity of the equipment is approximately 100 cu. ft. per min. of atmospheric air at 3°C.

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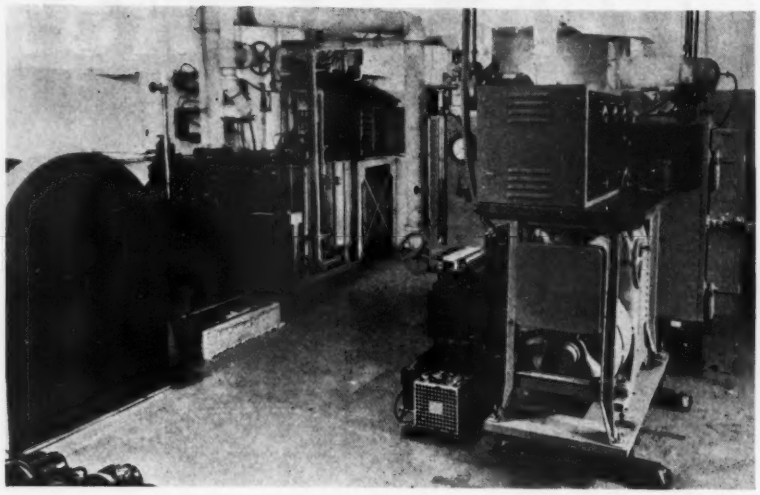

FIG. 2. Overall view of high-altitude equipment. Chamber is just behind the test stand in the foreground.

for a period of 6 hours. The dew point temperature of the air leaving the dryer is −50°C.

The precooler reduces the temperature of the air entering the dehumidifier to 3°C., lowering the moisture content of the air before it enters the dryer. The precooler is a conventional heat exchanger using coils surrounded by a galvanized metal housing that collects the moisture dropping from the dehydrating coils. An air-cooled compressor supplies the refrigerant to the cooling coils.

A single-stage, straight-line, horizontal, crosshead type vacuum pump is used for evacuating and pulling air through the system. The cylinder bore is 22 in.; stroke, 9 in. A 40-hp. electric motor drives the pump at 300 r.p.m. A pressure-relief valve was installed in the vacuum line for regulation of the vacuum in the chamber.

The generator on test is driven through a special vacuum-sealed shaft passing through the wall of the chamber. Outside the chamber and coupled to the drive shaft is apparatus designed especially for testing d.c. aircraft generators in accordance with Army Air Forces Specifications. This consists of a 15-hp., 1,200-r.p.m., 220-volt, three-phase, 60-cycle motor driving through a variable-speed unit to the output shaft. A control panel with ammeter, voltmeter, tachometer, and control switches is part of the test stand.

OPERATION OF EQUIPMENT

The design of the equipment is such that part of the control is automatic and the other part manual. The temperature control is maintained by recording controllers, and all pressure control is manual. The operation of the equipment for driving the generator and all electrical measurements is manual. When equipment being tested requires blast cooling, the temperature of the air pumped into the chamber is controlled automatically; however, manual operation is used for control of the ambient temperature in the chamber.

Three types of tests are conducted in the chamber.

Blast Cooling

Equipment requiring blast cooling, such as an aircraft generator, is installed in the chamber, and flexible-tube connections are made from the point of entry of the cooling air to the generator (see Fig. 1). Evacuation to the desired altitude is accomplished within ½ min. When the desired altitude is reached, the throttle valve is opened and air flows in through the precooler, dehumidifier, air cooler, generator and on into the chamber from which it is exhausted by the vacuum pump.

The temperature of the air passing through the air cooler is gradually reduced until the desired air temperature is obtained. At this time it is considered that altitude has been reached. During the time required to reach altitude conditions, the generator can be run at any desired speed or load.

If preferred, the pressure can be reduced slowly to simulate an airplane climbing into the stratosphere; however, test results are not materially affected by the sudden evacuation. The maximum obtainable altitude when blast cooling depends upon the quantity of air pumped through the system. When 6 lbs. of air per min. are pumped through, the maximum altitude is 50,000 ft.

Chamber Cooling

When tests are such that no blast cooling is required, the chamber temperature can be reduced by pumping all the coolant through the coils inside the chamber. Evacuation can be done immediately or as slowly as desired with the small pump on the chamber. For altitudes of from 50,000 to 70,000 ft., the large vacuum pump is used. The minimum temperature to which the chamber can be cooled is −65°C., requiring approximately 1½ hours to reach this condition. Temperature control of the chamber in such tests is automatic.

Elevated Temperature Tests

The temperature of the chamber can be elevated to 70°C. and the moisture content of the air maintained accurately from 40 to 100 per cent relative humidity. Such control is used to produce conditions found in tropical countries

ALTITUDE TESTING

Tests to simulate conditions found in the stratosphere are conducted at pressures and temperatures comparable to those found in flight. Because of the importance of testing in dry air, the air supplied through the blast-cooling system or the air inside the chamber is always dried to a dew point less than −50°C.

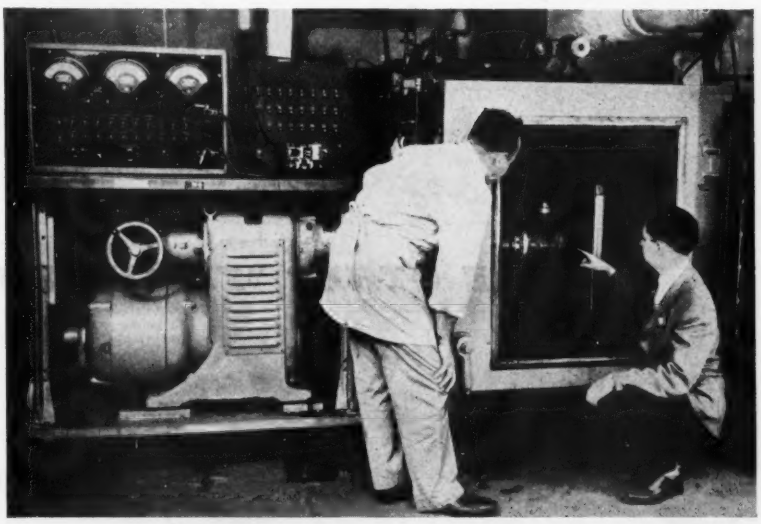

FIG 3. Altitude chamber with open door, test stand on the left. Note generator in position for test.

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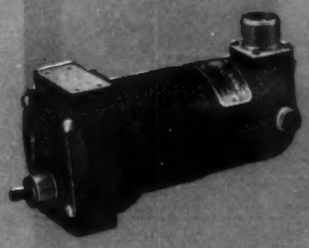

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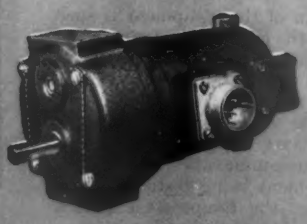

Inter-cooler Door Motor is a vital part of the supercharging system which has made planes effective at high altitudes.

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NOR TOO COLD"

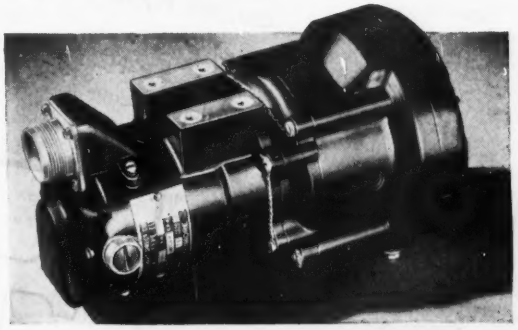
Ever think of an engine's cowl flaps as its "horse blanket"? One horse or two thousand—the best work may be expected when the surrounding temperature is controlled so that it's neither too hot nor too cold. So, just as the blanket keeps the temperature *warm* enough for Dobbin, the cowl flaps of the Lockheed Ventura keep the temperature of its 4000 h. p. team of twin engines properly *cooled.*

Four Dumore Aeromotors actuate theVentura's cowl flaps, correctly controlling the amount of cooling air circulated according to the varying requirements of operating conditions. Keeping engine temperature within safety limits maintains the performance efficiency of the plane's power plant—a fundamental factor upon which the Ventura's fighting ability depends.

Almost every type of American military aircraft is served by Dumore Aeromotors, actuating parts and accessories vital to its operation and effectiveness as an aerial weapon. All these motors embody the experience Dumore has had over many years of manufacturing to specifications for exacting drive applications. Operation and control accessories (brakes, clutches, limit switches, gearing, potentiometers, etc.) are designed to be integrated into one compact motor unit—achieving maximum operating efficiency, most favorable strength-to-weight ratio, and minimum service requirements. Aeromotor design incorporates provision for operation at altitudes up to 40,000 feet and over a temperature range of from—65° to 160° F. The full, interesting story of Dumore Aeromotors is given in the Motor Catalog. Write for a copy today. The Dumore Company, Motor Division, Dept. MG10, Racine, Wisconsin.

MODEL 1003-263 COWL FLAP MOTOR

The Ventura's cowl flaps (and oil cooler flaps) are operated by a Dumore double reduction spur-geared motor with ball bearings. With a speed of 400 r.p.m. its output is 1/25 h.p. for intermittent duty. Adjustable limit-switches and a magnetic brake are built in to control overtravel and prevent jamming of the cowl-flap mechanism. A thermal protector guards against motor damage from stalls and persisting overloads. A potentiometer transmits flap position to an indicating instrument before the pilot.



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SOLID, ONE-PIECE forged steel construction is just one of the outstanding construction advantages of the new lightweight Thompson Hydraulic Pistons—now in production for a wide range of hydraulic control equipment on aircraft.

In place of conventional bronze head threaded to a piston rod, Thompson Pistons are hot-forged from solid steel stock. There is no threaded connection—therefore no possibility of rod loosening or leakage from this source. Large cross-sections ordinarily required have been replaced by a lightweight, thin-sectioned forged steel head with unusually high strength factors. Thompson forged construction has eliminated much of the machining ordinarily required, substantially lowering the unit cost and permitting faster production.

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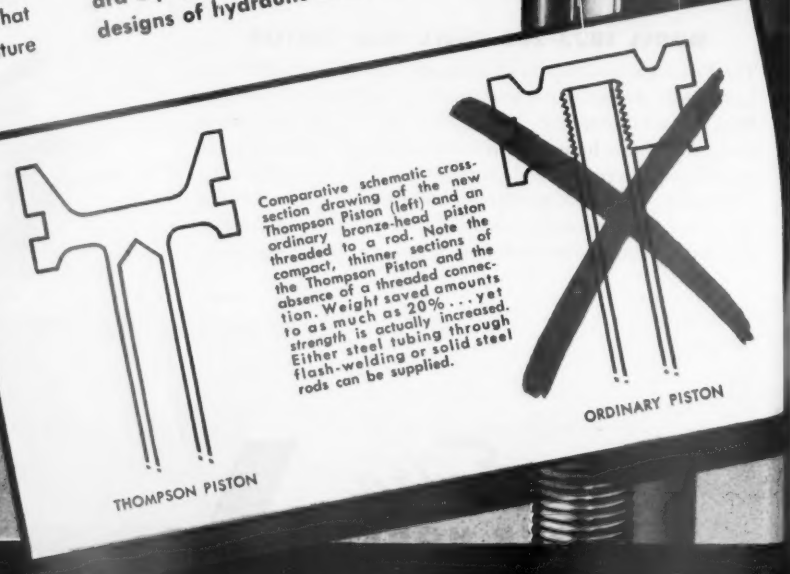
Thompson Pistons, through hot-forging, possess a grain structure in the metal that follows the contoured section—a feature that greatly increases the strength of the piston head. Heat treatment is performed under the most desirable controlled conditions to insure uniform hardness and toughness throughout. The entire piston is ground to precision dimensions and hard-chrome plated over the entire length to provide a smooth, non-scoring, long-wearing surface.

Thompson Pistons are available in sizes and types for any hydraulic application on aircraft . . . for operating bomb bay doors, landing gear, cowl flaps, etc., and for booster work . . . wherever positive-operating hydraulic equipment is required. They are standard equipment on many of the latest designs of hydraulic control units.



Comparative schematic cross-section drawing of the new Thompson Piston (left) and an ordinary bronze-head piston threaded to a rod. Note the compact, thinner sections of the Thompson Piston and the absence of a threaded connection. *Weight* saved amounts to as much as 20% . . . yet strength is actually increased. Either steel tubing through flash-welding or solid steel rods can be supplied.

THOMPSON PISTON

ORDINARY PISTON

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ARMY E NAVY

Thompson Products, Inc.

WEST COAST PLANT ★ BELL, CALIFORNIA

FIG. 4. Investigation of generator operation when covered with ice. This is an unusual condition seldom encountered.

When blast cooling is used, there are tests where the ambient temperature in the chamber is held at 30°C. In this case, the actual pressure is not a true indication of altitude because the pressure is measured at 30°C. and the air entering the chamber is perhaps −30° to −50°C. An altitude-temperature-correction factor is used to calculate the pressure for respective altitudes so that the density of air entering the equipment will be comparable to the density of air found in flight.

Generators on test are attached to the mounting bracket on the inside wall of the chamber (see Fig. 4, left center), the generator spline shaft being inserted into the coupling on the end of the pressure-sealed shaft. Leads are connected through the AN connector and run out of the chamber through two high-voltage terminals to the load banks built into the test stand. Thermocouples used for temperature measurement are connected through the chamber connector panel to a switch box on the test stand where temperatures are measured. Temperature rise, commutation, and arcing are investigated.

When motors are tested, some method must be used for applying a load. This can be done by having the motor drive a rotating machine of the correct load, such as a generator that is loaded as desired (see Fig. 5) or a fan that applies the correct load. The latter method is not completely satisfactory because changes in altitude will affect load.

A flat-spring coupling can be used for torque measurement. Deflection of the spring is calibrated for various torques. A stroboscope can be used to view the deflection when the unit is running.

Other tests can be conducted to simulate almost any condition under which aircraft accessories must operate. Conditions can be simulated representing the hot, moist jungles; the hot, dry desert; or the frigid, dry stratosphere.

In addition to electrical equipment, components of the equipment can be checked under the various conditions.

FUTURE TESTING

Arc rupturing for relays and switches, creepage over insulators, motor and generator ratings at altitude, brush wear, and commutation are but a few of the investigations that will be carried out to improve the operation of electrical equipment for our military planes of today and our commercial planes of tomorrow.

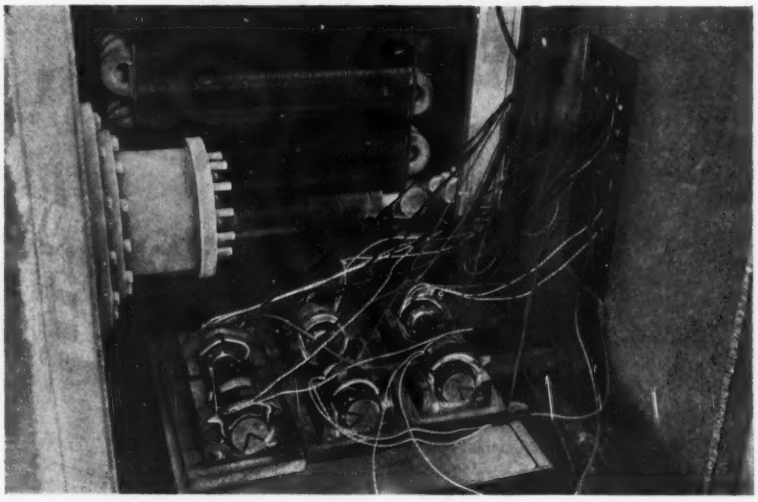

FIG. 5. Aircraft electrical motors on test. Generator mounting at left center. Two motors are coupled together, one running as a generator applying a load to the other unit running as a motor.

(*Continued from page 17*)

must be directed to the emergency landing runway. The planes already within the control area that have been assigned this runway will be directed to continue circling on the prescribed circling traffic path until they can be worked into the landing circle of one of the other open runways or until the runway can be cleared. If this emergency occurs on the right runway of the three, the same circling altitude can be maintained. If the stoppage occurs on either of the other two runways, an increased altitude must be assigned to all planes already on the circling path to the blocked runway so that they will clear the landing planes on the next runway to the right. Planes on the main traffic arteries feeding into the blocked runway traffic will immediately be assigned holding positions on the various circling hold areas back as far as the last airport of departure, until planes already holding within the airport traffic area can be worked into the landing traffic for other available landing runways.

Wind Shifts

Sudden wind shifts of over 90°, requiring reassignment of landing and take-off runways for all planes in the control area, will involve considerable work for the central control. To guard against such shifts coming unexpectedly, one or more meteorologists should be assigned to observe weather conditions approaching the area and to anticipate such events as sudden squalls, wind shifts, high wind conditions in clear weather, etc. As the wind shift approaches the airport boundary, all take-offs will be stopped and taxiing planes held until reassignment can be made. Planes already on the landing glide path will complete the landing. All planes on the circling landing paths will continue circling until the correct landing runways for the shifted wind

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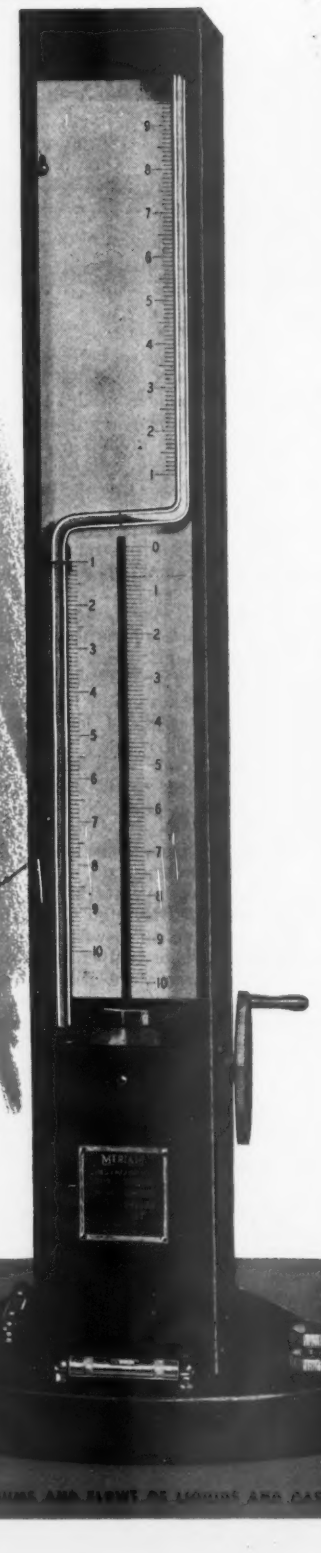

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can be determined and assignments made. Planes on all arteries feeding into the control area will be assigned holding areas as needed. Wind direction changes involving shifts to adjacent runways will require little or no traffic delay.

Single-Engine Failure

The major emergency on take-off is the case of single-engine failure at a point too late to land again on the runway. In this emergency, the plane taking off from the middle runway is in the most critical position, since the one on either side can be turned away from the center take-off path and at a suitable time can be directed into the general landing pattern or landed on the emergency landing runway. The plane taking off from the center runway with one engine out must necessarily proceed straight ahead, using all available power until safe turning clearance beneath take-off traffic and above obstructions has been obtained. It must then maintain altitude beneath that of traffic on the approach circles until it can either enter the general landing pattern or circle inside the landing pattern and land on the emergency landing runway.

To show relative spacing of airplanes in the airport control area with 1-min. separation for landing and take-off from each runway, small tabs have been clipped onto the threads. The traffic flow on these circling paths is at 150 m.p.h. for all landing circling paths to the point where the turn is made into the landing glide path. Normal cruising speed is maintained until the radio-range station at the boundary is crossed, at which time the speed must be changed as rapidly as possible to 150 m.p.h. true air speed. This speed must be maintained by all planes—large and small—in this traffic pattern until the plane turns into the glide path. From this point to the point of landing the speed must be reduced according to a prescribed schedule to be worked out in relation to the circling altitude and the distance out from the end of the runway for the particular plan under consideration.

The consideration of the problems herein presented is no dream of the future. These problems are of an immediate nature and must be solved with application and decision if the air lines are to handle expected traffic within the next 5 years adequately and safely. It is estimated that from ten to 15 large cities in the United States will require greatly expanded airport facilities immediately after the war. The air lines must have adequate answers to the traffic problems involved in order to justify the expenditures of the large sums required to build extensive central airports capable of handling all air traffic through such cities. The entire problem is of vital interest to the Army, Navy, and Civil Aeronautics Administration, as well as to the air lines, and any system adopted must be uniform throughout the country and the continent and must be usable by planes of all agencies and all foreign air lines.

(*Continued from page 9*)

and for the growth of private flying, that large numbers of young men and women learn to fly every year. In my judgment they can best receive primary instruction while students at high school and college as part of their regular school activities. A successful program for giving such instruction has been developed during the last 5 years under C.P.T., with private flight contractors giving the instruction and the school giving the ground-school training. This program has proved its worth and should be continued in modified form. Federal financial assistance for such flight training is thoroughly justifiable, but, in my opinion, it should only be given to that portion of the school population which shows unusual interest and ability in aviation as indicated by good marks in ground-school studies or some other similar criterion.

Advanced training for military flying should, of course, be given by Army and Navy personnel, but in the future there should be no more need for the Services to teach primary flying than for them to teach their men how to drive automobiles.

Subsidizing Private Flying

The distinction between learning and practicing the art of flying is sometimes overlooked. In a recent survey a number of airplane manufacturers expressed the belief that the Government should provide some sort of subsidy for private flying but should not continue an educational program such as the C.P.T. To me this seems to be a suggestion that the Government help finance a school of experience while refusing to support a school of primary education. However, the views of these manufacturers deserve consideration and I should like to make some comments thereon.

It should be manifest that any material market for the personal airplane must come from those who have had their preliminary flight instruction and continue on flying. Primary instruction at best represents about 50 hours of flying per individual which should, if we are to have a private aircraft industry, represent only a small fraction of the total hours of flying for each individual. Primary flight instruction should, therefore, be considered as a means of creating a private market for the personal airplane and should not be considered a market in itself. Subsidizing private flying does not create a private market for the personal airplane but rather a combination Government and private market.

Some manufacturers expressed the opinion that C.P.T. did not provide a private market. I am inclined to believe that this is a short-range view. A reference to market estimates based on expenditure distributions of families in various income groups will illustrate my point. Consideration of the expenditure distribution of a particular income group does not leave much room for optimism in predicting personal airplane sales. Families already in these income groups have acquired spending habits over the years, and it will be difficult to persuade them to change their habits to accommodate the cost of the personal airplane. However, if the desire to own an airplane is instilled in youth, then as young men and women move up on the income scale they will give the personal airplane a high priority in the budget as a matter of course. If I am right in this analysis, then a most promising method of creating a personal airplane market is to instill a desire for the personal airplane in those who may not immediately become prospects for it but who will gradually increase their expenditures on private flying as their incomes increase, rather than follow in the footsteps of their predecessors in establishing other spending habits. The first step in this process would be flight instruction for youth, and the second step would be well-developed rental and club ownership systems to permit them to continue and to increase gradually their flight activities.

Conclusions

Summing up, I believe the Government's place in the development of private flying should be:

(1) To provide Federal aid in the construction of landing fields and promote and assist in the provision of a system of markers for the private pilot throughout the country.

(2) To conduct basic research projects looking toward the improvement of the personal airplane.

(3) To limit its regulation to that regulation required to provide reasonable protection for the public.

(4) To promote aviation education in the schools, including financial assistance for flight instruction.

Don't Handicap Important Designs

for Lack of a SMALL Electric Switch

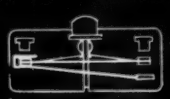
3 basic contact arrangements

single-circuit, normally open

single-circuit, normally closed

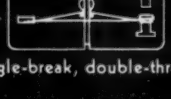
double-circuit, one normally open and one normally closed

And many special forms. For example:



three-point structure

single-break, normally open



single-break, double-throw

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Two terminal arrangements are available—out the ends of the case as shown above, or out the top through the cover. This makes for easy mounting in any position.

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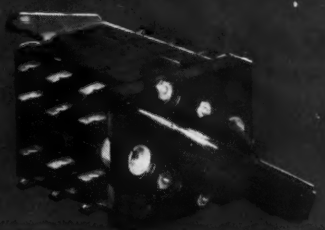
These enclosed plunger-operated limit switches use standard Switchettes as the contact mechanism.



This multicircuit switch, made up of six Switchettes, controls as many as twelve circuits from a single location. Switches like this can be made up using from four to fourteen Switchettes.

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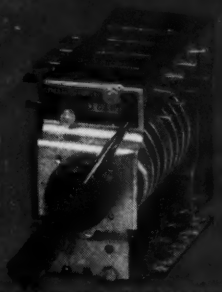
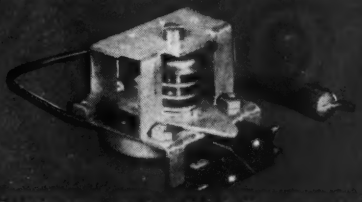
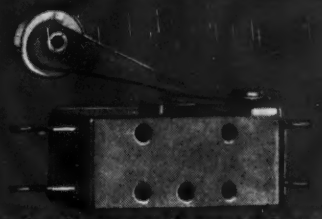


Compact selector switches like this, operated by cams, are available to operate as many as fourteen Switchettes in any desired sequence.



A Switchette is used in this bellows-operated thermostat for automatic temperature control.



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Many more control devices, including push-button stations, timers, and other types of limit switches, are built around G-E Switchettes and are available for your use. If you don't see what you want here, ask for it. Chances are we have just the devices you need—if not, we may be able to modify existing designs to serve your purpose. Or, if you prefer to work Switchettes into your own designs, our engineers will be glad to help you.

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Introduction

The design of any practical helicopter involves neutralizing the reaction torque of a driven rotor. Compact simpler craft can be developed when the rotor itself acts to neutralize reaction torque at the hub, permitting the rotor to function as a simple tractive device without reaction torque.

The rotor is susceptible not only to spin but also to other simultaneous motion relative to the craft. The whole spinning rotor can be caused to execute various cyclic maneuvers that are unnatural to it and which therefore require the continued application of specially directed forces for their maintenance. One of the simplest of these is forced precession, and this precession may be either with or against the direction of rotor spin.

Forced Precession

Precession counter to the direction of rotor spin requires the application of a sustained torque force in the direction opposite to the torque force employed to spin the rotor. This can effectively neutralize the reaction torque of rotor spin, not by causing that unwanted force to vanish but simply by deflecting it to differently directed forces that can be conveniently accepted. There is nothing paradoxical about this conversion of a force to an equivalent force differently directed; it is the most familiar principle of powered flight, if not of all mechanics.

The sustained couple applied to precess the spinning rotor can be made variably adjustable relative to the torque that spins the rotor, thus providing a means for turning the craft at will by deliberately undercorrecting or overcorrecting for reaction torque or for maintaining a fixed direction by holding the opposed couples in balance.

The mechanics of the problem are simple and their embodiment as a rugged mechanism is not difficult. Both the principle and the mechanism are explained and illustrated here.

The Mechanical Principle

The only reason for including any analysis of forces in this article is to explain the principle of how this forced counterprecession neutralizes reaction torque. Every possible simplifying assumption will be employed, and it must not be construed that the simplifying assumptions are supposed to be met with in any real construction. For instance, it will be assumed that the whole construction, including the rotor blades, is perfectly rigid. This is only one of many simplifying assumptions that will be employed, for the purpose here is not to design a helicopter but to introduce a principle whose practical application is another matter altogether and quite beyond the scope of this article.

In Fig. 1, Y-Y is the axis of the drive shaft. This is also the axis of the normal reaction torque. In Fig. 1 the rotor spins about an axis Y'-Y' inclined to the axis of the drive shaft. ϕ is the angle of inclination. The axis Y'-Y' is not fixed in direction but is forced to precess about the axis Y-Y in a direction counter to the spin of the rotor. Both the spin and the precession are forced rotations and their respective angular velocities are independently determinate.

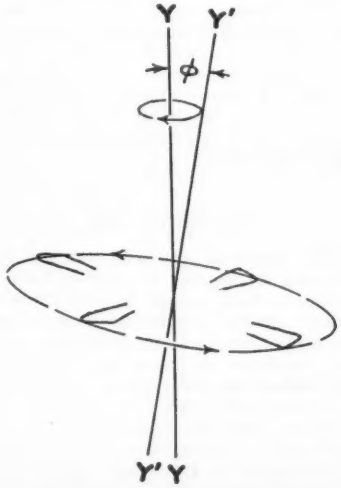


Fig. 1.

Unbalanced Residual Forces

Aside from unprecedented stresses imposed on the rotor blades and influencing their design, certain identifiable new unbalanced forces remain after the lift is balanced against gravity and the precessing torque balanced against the spinning torque. Each of these remaining unbalanced forces will be separately examined a little later. They represent the deflected transformed normal reaction torque, and countering these unbalanced forces, once they have been rendered in manageable form, is a final refinement to be dealt with as a problem of detail design.

These unbalanced residuals consist of horizontal traction at the hub and several component overturning couples. The latter can be expressed as a single resultant overturning couple. Both the horizontal traction and the overturning couple rotate with the precession, in fixed phase relation, and about the axis of forced precession.

The Rotating Horizontal Traction

The rotating horizontal traction can be countered by a single eccentric weight rotated with the precession and generating a centrifugal force equal and opposite to the horizontal traction. Precessing the rotor about an axis that does not pass through the center of gravity of the rotor could employ the rotor mass itself, and no added weight would then be required. Either of these stratagems would add one more residual overturning couple, but that would only require to be accounted for when reckoning the resultant residual overturning couple.

Residual Overturning Couple

Any residual unbalanced overturning couple could be similarly countered by two equal opposed eccentric weights, vertically staggered, and rotated with the precession so their centrifugal forces would effect a righting couple. The same thing could be accomplished by correct angularly eccentric disposition of the rotor axle relative to the axis of

* Engineer, Sales Department.

precession, and no added weight would then be required.

Whether countered by the obvious expedient of revolving counterweights or by the less obvious device of eccentric mounting of the rotor axle, revolving horizontal traction and revolving overturning moment are forces that can be balanced out by reasonably simple means. The following analysis will therefore be confined to explaining how the normal reaction torque, when it has been countered by forcibly contraprecessing the spinning rotor, reappears as revolving horizontal traction and revolving overturning moment. The final balancing out of these residuals will not be dealt with in this article in any further detail than above.

Dynamics and Aerodynamics

It might be a welcome simplification if aerodynamic considerations could be ignored for this discussion. But when the rotor itself is called upon to act to neutralize its own reaction torque, aerodynamic considerations are important. The presence of a fluid medium cannot be ignored for any problem involving rapid forced manipulation of the rotor in any direction.

The simple dynamics of the system might still be examined separately from the aerodynamics by first construing the problem *in vacuo*. Here there would be no external resistances, no lift, and, with all elements of the system freely falling through empty space, no effect on the system by gravitational force. The resulting complete absence of any righting force or even of any natural fixed axis of reference renders analysis of the dynamics *in vacuo* inconveniently elusive. To examine the aerodynamics first is equally valid and much easier to follow, ignoring any moments developed by simple dynamics. The dynamic effects are then imposed on an aerodynamically balanced system.

Components of Traction

The rotor spinning about an inclined axis will develop one principal component of traction directed vertically to countervail gravity and one lesser component directed horizontally, applied at the hub and rotating with the forced precession. This precessing horizontal traction is the most obvious of the unbalanced residual forces and the only one that is not a purely torque force. The reaction torque of rotor spin also resolves into two component torques: a principal torque about a vertical axis and a lesser torque about a horizontal axis. Only the principal component about the vertical axis is neutralized by the forced precession; the lesser component persists as one of the unbalanced residual overturning couples, rotating with the precession.

The rapidly precessing axle will force the rotor blades to beat rapidly up and down in a cyclic pattern of behavior. This is true whether the rotor spins backward, spins forward, or does not spin at all. This cyclic vigorous up-and-down beat of the blades combines with any rotary motion imparted to the blades by the spin but remains an extra, separately identifiable, superposed component of their motion. The rotor blades, whatever the detail of their design, cannot be waved rapidly up and down without meeting resistance from the air through which they are waved. This resistance can be overcome only by force, and that force is the torque required to precess the spinning rotor.

This aerodynamic resistance to forced precession of the rotor disc manifests itself as an unbalanced residual overturning couple, rotating with the precession and approximately in phase with the residual overturning couple of the horizontal component of reaction torque.

By assuming now that these three aerodynamically developed unbalanced forces—one horizontal traction at the hub and two overturning couples—have been perfectly countered by counterweighting or by the equivalent eccentric mounting of the rotor, the craft will be maintained in aerodynamic balance and the simple dynamics of the system can be examined as an additive effect.

Gyroscopic Properties of the Rotor

The spinning rotor has inherent gyroscopic properties, and, if the craft is held otherwise virtually fixed by a balance of all other imposed forces, contraprecession of the spinning rotor will develop a sustained gyroscopic couple tending always to increase the angle in Fig. 1—that is, to overturn the craft in the direction the axis of spin is instantaneously inclined. This introduces an unbalanced residual overturning couple, out of phase with those derived aerodynamically, and rotating with the precession. This couple can be countered by a final readjustment of the assumed counterweighting or of the alternatively assumed eccentric mounting of the rotor.

Recapitulating, the force of gravity is balanced by a slightly diminished vertical component of rotor traction, the normal reaction torque is balanced by an opposed reaction torque developed by forcibly precessing the spinning rotor in the direction opposite to the spin, and two residual unwanted forces persist—one a horizontal traction at the hub and one a resultant overturning couple. These unwanted residuals can be countered by proper eccentric disposition of the rotor axle relative to the axis of precession.

The Mechanism

The practical problem reduces to selecting an angular velocity of forced precession high enough to keep the required value of ϕ quite small, while at the same time avoiding induced resonant vibrations and providing a mechanism embodying the required principle. This mechanism must be capable of smoothly variable adjustment of at least one determinant variable factor of resistance to precession. That determinant factor may be the angular velocity of the forced precession relative to the angular velocity of the rotor spin, or it may be the angle of inclination ϕ. Since it is simpler to arrange for fixed relative angular velocities via meshed gears and make the angle ϕ variable, this is the alternative to be employed for the mechanism.

The description and illustrations that follow are frankly and intentionally schematic. The proportion of the parts, the arrangement of bearings, and all other details have been selected to illustrate as simply as possible the operating principles and do not represent the appearance of any probable serviceable design. The rotor is shown mounted in the neutral or index position, for the specific eccentricities necessary to counter the unbalanced residual forces are a function of the dimensions, mass, aerodynamic characteristics, and angular velocities of the specific problem.

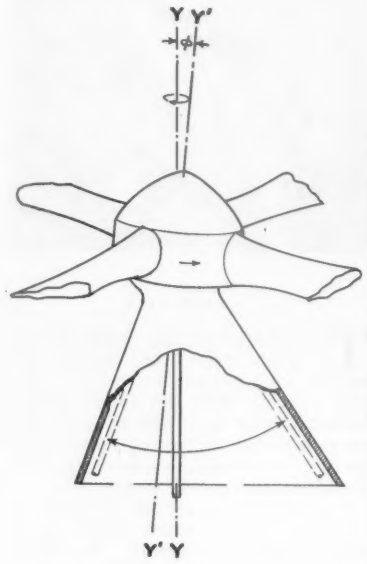


Fig. 2.

Fig. 2 shows a partially cutaway view of the rotor and a hollow pyramidal mast that houses the drive shaft and through which the lift of the rotor is applied to the craft. The drive shaft can be swung aft or forward within the mast, pivoting at the hub as indicated, to effect a forward or reverse component of the lift and can be swung laterally to a less degree to compensate for drift due to side wind. This general arrangement is essentially conventional. Our interest is centered at the hub where the construction is quite unconventional.

Details at the Hub

Fig. 3 shows the details of construction at the hub. A cylindrical spool, B, is rigidly keyed to the top end of the shaft, A. The axis of the bore of this spool is inclined to the axis of the spool itself, so that the axes of the assembled

(*Continued on page 183*)

The B.F. Goodrich Airline of the month

ALL AMERICAN AVIATION, INC.

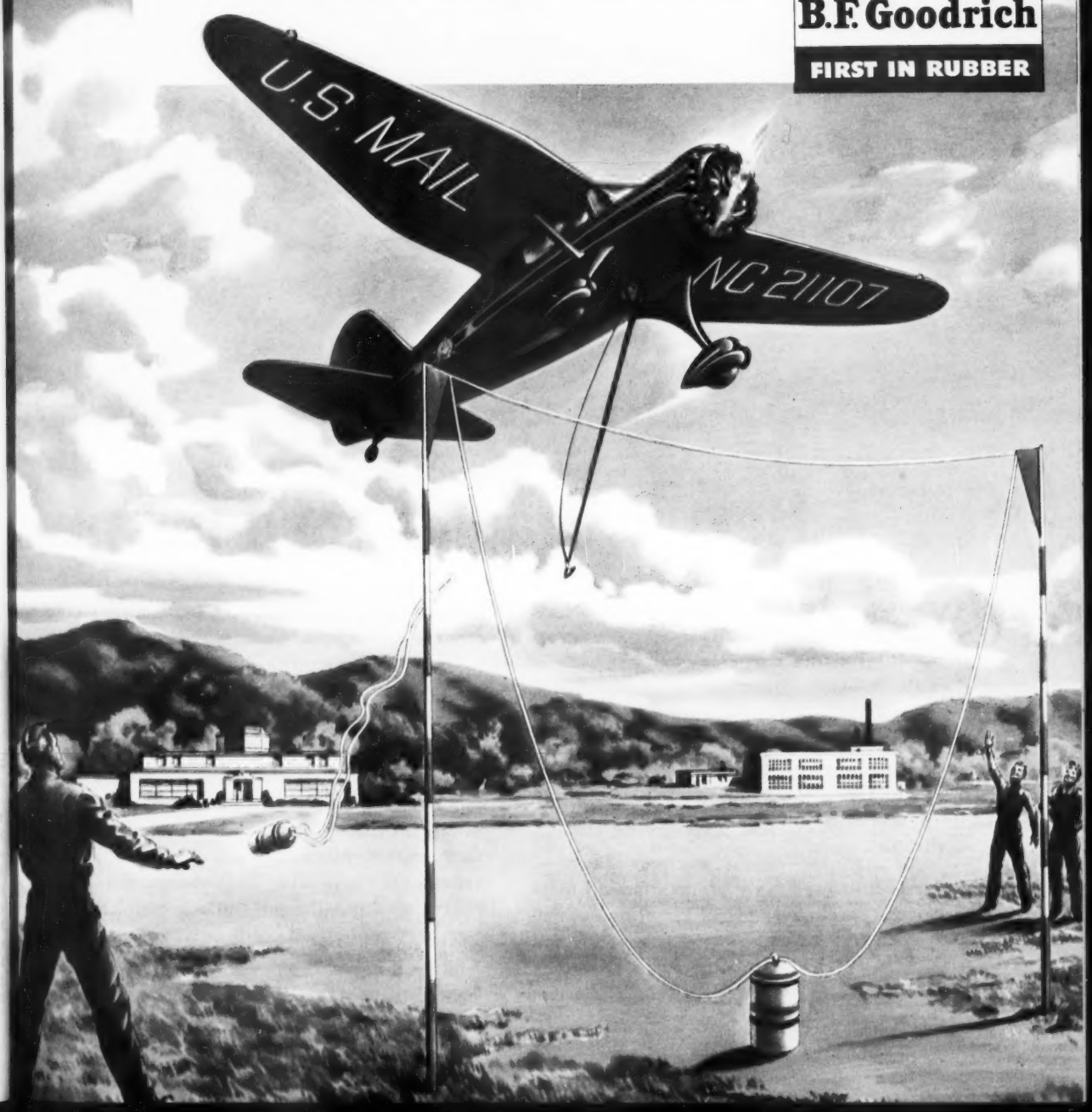
FIVE ROUTES radiating from Pittsburgh, Pa., serve 107 cities and towns in six states with a new form of fast communication—the Air Pick-Up. All American Airlines, Inc., operate a fleet of light, 2-man planes over these routes. They swoop down at pick-up stations—drop a bag of mail and express, and pick up another—all on the fly. By acting as a feeder to main trunk lines, and serving areas without regular airport facilities, All American is bringing closer the day when air service will be available to everyone.

B. F. Goodrich, maker of Airplane Silvertowns, Expander Tubes for brakes, De-Icers, and more than 80 other aviation products, salutes All American for their excellent service record. They've earned the nomination as this month's "Airline of the Month."

In war or peace

B.F. Goodrich

FIRST IN RUBBER



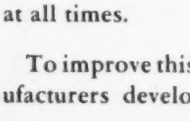
New hydraulic hose means

WHEN A WARPLANE comes back to base with its hydraulic lines shot up, they must be replaced before that plane can get back in the fight. Replacing damaged hose sections used to be a complicated, time-consuming process. Attaching stock hose to couplings required a giant press . . . and not many advanced bases had them. The only alternative was to keep thousands of different hydraulic assemblies on hand at all times.

To improve this difficult supply situation, manufacturers developed special couplings which could be attached quickly and easily to the stock hose then available. But they weren't successful, because the rubber in the hose would stretch and flow when squeezed between the parts of the coupling—then pressure would pull the coupling loose.

B. F. Goodrich engineers were asked to develop a hose which would make the use of these couplings practical. The result was a hose with no layers of rubber outside or between the cord plies. Instead, protecting rubber was forced down into the fibres of the cord as it was braided around the inner tube. Thus there was no free rubber to flow—the jaws of the couplings bit into hard rubberized cords only, and held!

This new hose is 30 to 50% lighter and from 20 to 50% stronger than the old type. It is the



Awards to 9 plants

STRONGER, LIGHTER HOSE OPERATES AT LOW TEMPERATURE

Here's the new B. F. Goodrich Hose (Spec. ANH6a) that simplifies front-line repairing of the medium pressure hydraulic lines in our warplanes. Since it has no free rubber to stretch or flow, new couplings can be attached and not pull loose under pressure. Specially compounded for use in working conditions as low as —65° F., this hose is now Army-Navy standard for medium-pressure control lines.

faster front-line repair

only hydraulic hose that is size-controlled within such close dimensions that reattachable couplings can be used.

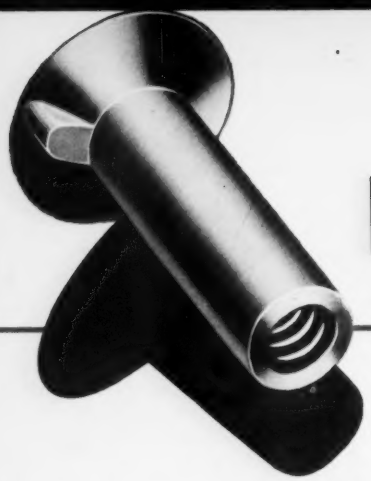
Now Army-Navy standard for aircraft medium pressure control lines, this B. F. Goodrich hose is greatly simplifying front-line repair. For instead of having to stock thousands of different complete assemblies, a few sets of couplings and a few reels of hose are all a base needs to keep its planes in the air. Assemblies are made up on the spot.

The use of this hose has benefited the war effort in another important way. Demand for the type of hose formerly used for both medium and high pressure lines far exceeded production capacity. The adoption of this new B. F. Goodrich Hose for all medium-pressure installations has greatly relieved a critical supply situation. The B. F. Goodrich Co., Aeronautical Division, Akron, Ohio.

In war or peace

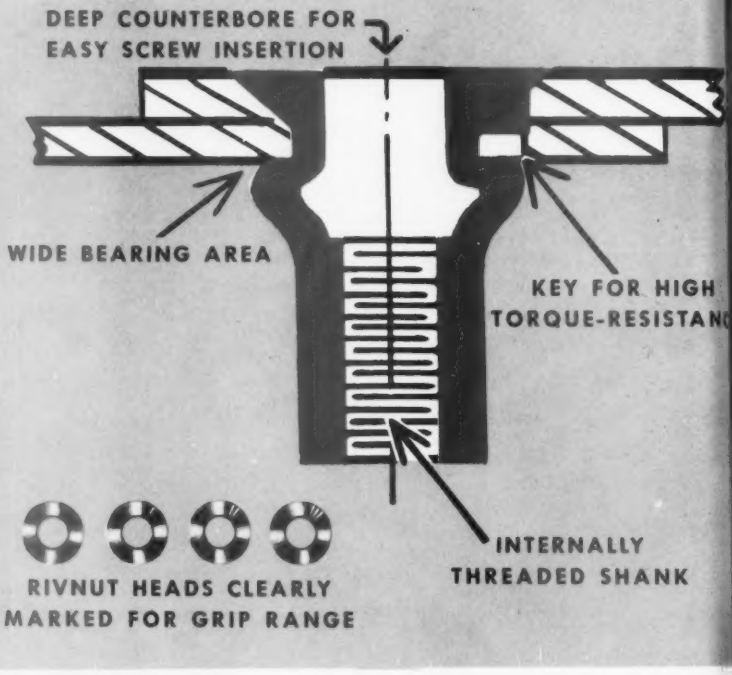
B.F.Goodrich

FIRST IN RUBBER

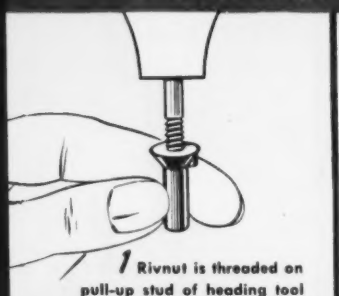


All these advantages make the RIVNUT an ideal blind fastener

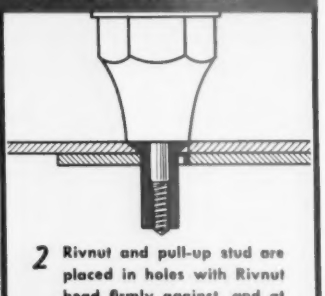
- Installed and headed from one side
- Serves as rivet, as nut plate for attachment, or as both at once
- Simple one-piece construction
- Corrosion-resistant aluminum alloy
- Light weight—low cost
- Requires very small hole
- Forms compression fit
- Ready for use "as received"
- Can be used in metal, plastics or plywood


DEEP COUNTERBORE FOR EASY SCREW INSERTION
WIDE BEARING AREA
KEY FOR HIGH TORQUE-RESISTANC
INTERNALLY THREADED SHANK
RIVNUT HEADS CLEARLY MARKED FOR GRIP RANGE

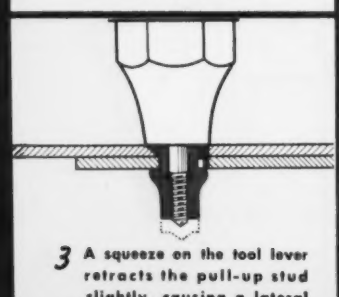
SIMPLE INSTALLATION IS BIG RIVNUT ADVANTAGE



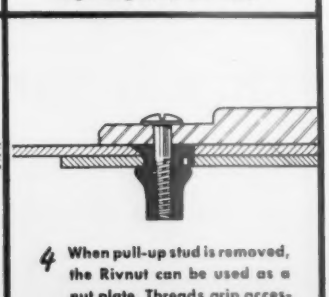
1 Rivnut is threaded on pull-up stud of heading tool until it touches the anvil.



2 Rivnut and pull-up stud are placed in holes with Rivnut head firmly against, and at right angles to, the work.



3 A squeeze on the tool lever retracts the pull-up stud slightly, causing a lateral bulge upset of the Rivnut.



4 When pull-up stud is removed, the Rivnut can be used as a nut plate. Threads grip accessory screw firmly.

New Folder, "Rivnut Data," Free

If you're not already using B. F. Goodrich Rivnuts, get complete facts now about these versatile fasteners that cut costs and speed production. For your copy of a newly edited data folder, write today to the B. F. Goodrich Company, Aeronautical Division, Dept. 0770, Akron, Ohio.

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RIVNUT

IT'S A RIVET...IT'S A NUT PLATE

2000°
1800°
1600°
1400°
1200°

HIGH TEMPERATURES

...as they affect the properties and usefulness of metals

A metal's fitness for high temperature use is usually measured by two yardsticks:

1. *Its resistance to oxidation*
2. *Its strength and hardness*

at the temperatures it must undergo.

Getting a good rating on one of the two counts isn't enough. A thoroughly satisfactory metal for most heat-resisting use must get a high mark on both.

Resistance to oxidation is measured in terms of freedom from scaling and intercrystalline attack. High strength won't matter for long if a metal oxidizes and scales, thus reducing in cross-section, or if intercrystalline change saps its vitality. Also, in many applications, the scale that flakes off is one more complicating factor.

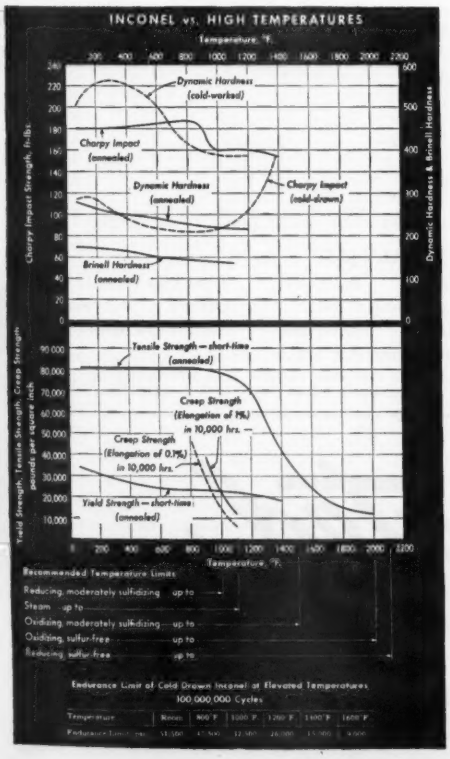
On the other hand, an oxidation-resistant metal that is too soft or weak to support its required load in the high temperature range is out from the start.

Strength for heat-resisting service is measured by a series of tests, the most important of which is the creep strength of the material.

In this test, the metal is subjected to known stress under controlled temperature and atmosphere conditions. The results are reported as pounds of stress necessary to produce an elongation over a prolonged period of time.

Along with this basic test for high temperature usefulness are others which determine the endurance limit, impact strength, short-time tensile strength, and hot hardness . . . all of which help give a "yes" or "no" to the metal's selection for high temperature use.

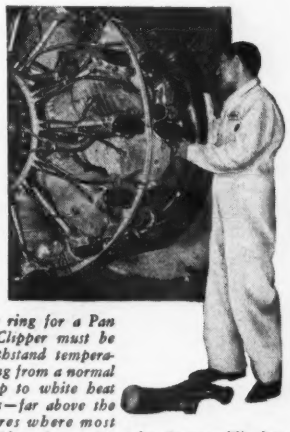
The results of these tests in the chart below show the reasons for the remarkable high-temperature service life of the nickel-chromium alloy Inconel.



For most purposes . . . and especially for applications where mechanical stress is involved... Inconel is outstanding even among the heat-resisting INCO Nickel Alloys for service at the highest temperatures. Inconel fights off progressive oxidation. It is little affected by thermal shock, or sudden, wide swings in temperature. It holds up well under both suddenly applied and constant load and it is a workable material which can be formed into complicated shapes and welded to produce ductile joints that endure constant vibration without cracking.

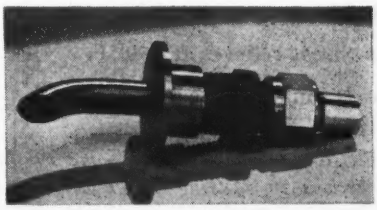
An aeronautical use that points up some of the properties of Inconel is the collector tube on the fuel-air mixture indicator for bombers and fighters. Continuously exposed as it is to the direct blast of corrosive exhaust gases at 1400° F., the tube must combine freedom from oxidation with strength at high temperatures. No other material has been found which does this particular job as well as Inconel.

The many heat-resisting properties of Inconel are demonstrated, perhaps even more graphically, by the exhaust manifolds used on Pan American Clippers.



A collector ring for a Pan American Clipper must be able to withstand temperatures ranging from a normal 1500° F. up to white heat on take-offs—far above the temperatures where most metals would weaken, warp and scale away. The hot strength of Inconel is its chief value as a material for exhaust manifolds.

Here, the same red-hot blast of exhaust gas is encountered as in the collector tube. Intense vibration and exceedingly quick temperature changes are piled on top of the corrosive and strength-sapping attack of the hot gas. Despite these destructive factors . . . and the very light gauge of the sheet used . . . many of the Inconel manifolds have seen more than 5000 hours of flying service *without repair.*



Continuously exposed to aircraft exhaust fumes at around 1400° F., this collector tube for a fuel mixture indicator is made of strong, heat-resistant Inconel. Tube is product of Cambridge Instrument Co., New York, N. Y.

For further information regarding the properties and working of INCO Nickel Alloys, write for a copy of the new booklet "INCO Nickel Alloys for the Aircraft Industry." A copy is yours for the asking.

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FEDERATED ALUMINUM ALLOY 150.4*

Typical Sandcast Properties	*Tensile Strength P.S.I.*	*Yield Strength P.S.I. (0.2% offset)*	*% Elongation in 2"*
As cast	27,500	17,500	2
As cast and stress relieved (5 hours at 450° F.)	28,000	22,000	3
Solution Heat Treated 12 hrs. at 980° F., quenched in boiling water & aged 3 hrs. at 310° F.	35,000	25,000	2½
Solution Heat Treated 12 hrs. at 980° F., quenched in boiling water & aged 3 hrs. at 400° F.	42,000	37,000	1½

ANALYSIS

Copper	1.25-1.75	Zinc	0.2-0.4	Titanium	0.2 Max.
Silicon	5.0-6.0	Manganese	0.3-0.9	Others	0.2 Max.
Magnesium	0.35-0.55	Nickel	0.2 Max.	Aluminum	Balance
Iron	0.5 - 0.9	Chromium	0.2 Max.		

*Our aluminum alloy numbers indicate nominal composition to the nearest per cent by the following sequence of elements: Cu (1) — Si (5) — Mg. (0.4) etc.

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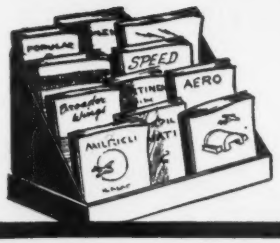


Periodicals

Accessories and Equipment

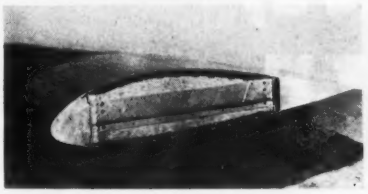
Equivalent Charts for Aircraft Plumbing Fittings. A series of charts of tube fittings, hose fittings, and pipe fittings prepared by American Airlines, is shown. These charts outline AN fittings equivalent to AC810 (Parker Standard type) and AC811 (Parker Triple types) tube fittings, as well as AN pipe and hose fittings for existing AC and Parker types. *Aviation*, May, 1944, pages 165–184, 406 illus.

Aerodynamics

Methods for Determining Airfoil Pressure Distribution. Monroe A. Maller. The practical steps required in estimating airfoil pressure forces are collated for the benefit of those who may be called upon to apply experimental data obtained from tests. The article gives the fundamentals involved and their relationship to the conception of pressure distribution. It begins with definitions of the properties and quantities with which the discussion is concerned and then describes the testing techniques adopted. The article is limited to two-dimensional airfoil models, the construction of which is described and illustrated. The theory of pressure distribution is explained with the aid of mathematical formulas. Information resulting from the tests is analyzed and charted. *Aviation*, May, 1944, pages 141–144, 273, 275, 277, 10 illus.

Compressibility Effects in Aeronautics. Parts I, II, and III. W. F. Hilton. A lecture given before the Luton Branch of The Royal Aeronautical Society begins with an explanation of the incidence of compressibility effects and of the derivation of Mach numbers and Reynolds numbers. After a definition of shock stall, the effects of that factor on the performance of high-speed aircraft, as well as the shock effects on propellers and the properties of shock waves, are examined.

The second part of the lecture tells how photographs of shock waves are made. The explanation is illustrated by photographs of shock waves made by the expulsion of compressed air from a tube and of the compressible flow past a circular cylinder. The facts revealed by



A two-dimensional panel of "typical manufacture" type, used in tests for determining airfoil pressure distribution.

these tests and others showing the flow past an airfoil at high speed are studied. It is noted that the drag increases as the shock wave moves back along the airfoil and as the breakaway intensifies.

Part III refers to the compressible flow around the tips of high-speed propellers. Photographs show the wave formations at increasing speeds, each of which is explained. The lecture concludes with a discussion of the compressibility effects on lift coefficient and of the temperature effects at high speeds. *The Aeroplane*, April 7, 1944, pages 389, 390, 5 illus.; April 14, 1944, pages 411–413, 16 illus.; April 21, 1944, pages 448, 449, 8 illus.

Graphic Simplifications in Computing True Airspeed. Richard G. Smith. A method is given for the use of nomographs in simplifying the calculation of true air speed. The corrections necessitated by compressibility, air density, and temperature are explained. The nomographs for correction of observed strut temperature and for the determination of the square root of the density ratio are reproduced, with instructions for using them. It is stated that the method is useful in reducing the chances of errors in calculations. No attempt is made to discuss the sources of error in computations caused by instrument and pitot-static head position errors affecting both altimeter and airspeed meter readings. The theoretical treatment of the subject is also omitted. *Aviation*, May, 1944, pages 154, 155, 273, 4 illus.

Air Cargo

Looking Ahead to Air Cargo Markets. Part II. Robert K. Kinzel. The second part of an article evaluating the potentialities and limitations of future air-cargo markets. In this installment the writer suggests running several planes in one flight (the number of which can be decreased or increased, according to need, at different stops) in order to make the airplane's load-carrying capacity more flexible. He demonstrates why he believes the all-cargo plane will not come into general use immediately but will be preceded by planes combining passenger, mail, and cargo loads. He then goes on to outline a sales and service policy that would help air lines to obtain volume cargo business.

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STRONG, CORROSION-RESISTANT, WORKABLE

The superior workability of R-301 offers a major advantage in forming curved or flanged parts.

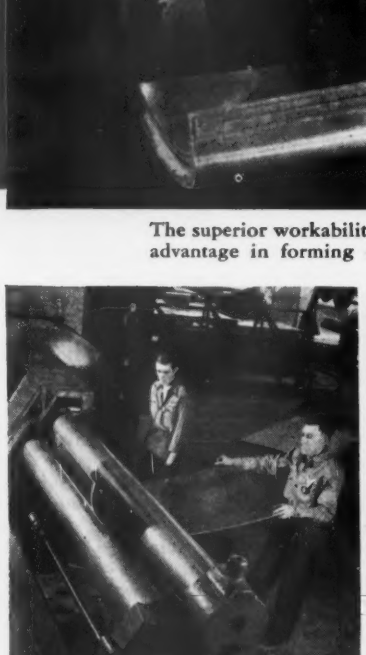
PLANE DESIGNERS wanted a higher strength aluminum alloy for increased performance. Aircraft shopmen wanted an aluminum alloy of good workability in order to reduce production time. Users of aircraft wanted an aluminum alloy with good corrosion resistance, to withstand *any* atmosphere and climate.

Reynolds' Metallurgists, reading these needs, created R-301.

R-301 is a high-strength aluminum alloy core, integrally bonded with a corrosion-resistant, medium-strength aluminum alloy cladding. The core and cladding alloys respond to the same heat treatment—resulting in a final product possessing high strength.

R-301 in the solution heat-treated temper is stable and more workable than any other high-strength aluminum alloy in the corresponding temper—thereby eliminating costly post-forming heat treatment and consequent distortion of aircraft parts.

R-301 is being produced in three tempers, suitable for a wide range of applications. Inquiries are invited. Reynolds Metals Co., Aluminum and Parts Division, Louisville, Kentucky.



Heavy, bending rolls, forming an armor hood for the pilot's compartment. R-301 can be cold-rolled to shape.

R-301 drills and routs to accurate contour. The surface cladding reduces ard of accidental scratch

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INGOT • SHEET • EXTRUSIONS • PLATE • ROD • FORGINGS • TUBING • FOIL • POWD

This policy encompasses four essential points covering ground service, a service division to be established as part of the sales department, consistent advertising to back up both trained sales specialists and service men, and commodity rates. In relation to the last point, the writer states that commodity rates, to bring in large volumes of business with regular movement, should be established only after careful study. *Aviation*, May, 1944, pages 185, 186, 267–269, 2 illus.

Packaging for Aircraft Units. Two methods of packaging aircraft engine starters for overseas shipment are described. One type of package consists of a plywood box or drum, inside of which is placed the starter or generator mounted on a wood base, covered with a moistureproof sheeting, and protected by a dehydrating chemical. The other type of package is a standard steel pail. The starting unit is placed inside of this pail, supported by wooden crates or papier-mâché shells. A dehydrating chemical is enclosed with it and the steel pail is hermetically sealed by a rubber gasket in the cover. Both containers were devised by Jack & Heintz, Inc. *Aero Digest*, May 15, 1944, page 121, 4 illus.

Air Law

Legal Notes on Air Transportation. George Boochever. The writer gives a brief description of some of the legislation concerning air transportation passed during 1943. It is noted that in 1943 approximately 1,000 bills were introduced in the state legislatures. Most of the bills failed of passage, but more than 230 were adopted and are now laws. *Air Transportation*, May, 1944, page 24.

Air Power

Airpower and Gunnery: The Battle of Truk. George E. Jones. The writer, who was a United Press correspondent aboard an American battleship, gives in narrative style a description of the action that took place during the American attack on the Japanese base at Truk. Naval formation is discussed, with emphasis on the services performed by the aircraft carriers—showing the tactics followed in the operation of that type of ship. The air phases of the attack are described in considerable detail, and the log gives a chronological review of what transpired. *Harper's Magazine*, June, 1944, pages 36–43.

"On the Threshold of the Invasion." Albert I. Lodwick. A report on the operations of the U.S. Army Air Forces in the United Kingdom. Briefly reviewing the growth of the Eighth Air Force in personnel, equipment, and airfields, the writer records the amount of German airplane and industrial destruction wrought by the Eighth Air Force up to the end of 1943. He commends the generals in charge of American air action against Germany and mentions the performance of several outstanding American airplanes. The operational skill required for sending huge forces of bombers and fighters from England and the work of the North Sea Patrol in rescuing air crews are noted. A German attack system is described: A bomb was towed on a cable fastened in back of a pursuit plane. When the pursuit plane would dive through Allied bomber formations the bomb would explode. It is stated, however, that a new system of defense completely neutralizes this strategy. *Aero Digest*, May 1, 1944, pages 51–55, 10 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Air Safety

Airline Safety—On the Ground, Too. Jerome Lederer. The first of two articles containing helpful information on how safety for ground personnel may be achieved. Accident prevention is discussed and some typical examples of accidents to air-line ground personnel are described. Consideration is given to the organization of the safety department. A chart shows how one air line's safety organization is set up, as well as the way it synchronizes with other departments. *Air Transport*, May, 1944, pages 32–36, 7 illus.

Air Transport

Continental Air Transport. V. L. Gruberg. Some of the manifold effects of the war on Continental Europe's civil air transport are outlined. The writer describes the present position of the Lufthansa and discusses the neutral countries' difficulties. A chart is furnished showing Axis-controlled air lines and neutral air lines in Continental Europe. *Flight*, April 6, 1944, pages 366–369, 2 illus.

Governing Principles for Expansion of U.S. Airline System. Part II. Lewis C. Sorrell. In Part II of a report prepared for the Air Transport Association and filed with the Civil Aeronautics Board broad principles are outlined for the development and control of air transportation on a national scale under government supervision. This installment deals with the organization of passenger service. The writer has added some new material not included in the A.T.C. document.

How the locational pattern of American cities conditions the planning of transportation routes is discussed. The analogy between railroad passenger service and the types of passenger carrying performed by air lines is described. The writer discusses linear routes, shared facilities, railroad overhead, air-line costs, and joint operating responsibility for local and trunk-line services. Other sections deal with surface-route structures and the disadvantage of the radial method of organizing local air-transport service. It is concluded that the preferable method of organizing local air service is the linear, or parallel-to-the-trunk-route, scheme. *Air Transport*, May, 1944, pages 57, 58, 61, 63, 66, 3 illus.

South American Air. Morris M. Mumper. A discussion of the trends of aviation and airport developments in South and Central America. The conclusions indicate that aviation progress is being fostered in the Latin American countries, that those countries offer a particularly fertile field for air transport, and that prospects of post-war air commerce between Latin America and the United States are bright. The writer quotes specific evidence of past developments and future plans to support his opinions. Among the phases of the problem which he considers are prospective equipment, airport facilities, purchasing power, and trained personnel. *National Aeronautics*, May, 1944, pages 23–25, 60, 2 illus.

Area Airlines for Small Communities. James G. Ray. The Vice-President of Southwest Airways Company advocates the establishment of feeder air lines to serve within small trade areas of the United States and suggests how such systems might operate. Indicating the feasility of this type of air service, he notes the successful record of All American Aviation in conducting area service within six Eastern states. The writer also describes the type of equipment which would be needed for area air lines and explains why he believes they should be operated by new air-line companies rather than by surface carriers or trunk-line companies. *Southern Flight*, May, 1944, pages 40, 41, 1 illus.

The Logic of Polar Air Routes. Bentley Barnabas. Advantages and disadvantages of the polar routes for air transportation are weighed. The propositions upon which the writer predicates his arguments in favor of the polar air routes are: (1) Great Circle arcs between resource areas offer maximum opportunity for refueling because land bases lie beneath their paths. (2) These same Great Circle arcs traverse routes between resource-collecting points that fit the highest use of the cargo airplane—namely, the carrying of products of high value and small bulk and weight. (3) Weather conditions offer advantages over other regions because storm belts are cut at their narrowest points and the Aleutian and Icelandic lows are generally avoided. (4) Such routes provide the shortest distances between an isolated continent—South America—and the rest of the world. South America possesses high-value resources that are needed elsewhere. (5) The industrial economy of

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the United States and North America actually requires those products that will be flown most economically over the northern routes. (6) Human traffic most often follows the path of high-value trading, and passenger revenue will thus accompany practical cargo revenue, though not in the same airplanes. (7) Maximum pay loads will accompany the opportunity for frequent refueling. (8) Safety accompanies land-based operations. (9) The routes provide a maximum of freedom from the hazards of icing and instrument flying. (10) Generally speaking, the weather is more predictable than that of more temperate regions.

Objections to the polar air routes examined include: (1) the difficulty of bringing fuel to polar land bases; (2) the question of how landings will be made on snowy fields; (3) the lack of short-haul business; and (4) the point that polar flying will not naturally follow present airways or describe Great Circle arcs from United States seaboard cities to other continents. Answering these objections, the writer's conclusion is that the obstacles are far outweighed by the advantages. He states that the tropics and the temperate ocean regions offer far greater hazards and economic disadvantages than the polar routes and that the latter offers the best chance to develop air commerce on a practical basis. *Western Flying*, May, 1944, pages 44, 100, 1 illus.

Archaic Air Travel Clauses in Life Insurance Applications. The necessity for including questions about air-line travel on applications for life insurance is protested. It is pointed out that, since it generally makes no difference in the cost of life insurance or in coverage if one is a habitual traveler on scheduled air lines, these questions serve no purpose but to discourage the use of air travel. Statistics are then quoted to show that scheduled flight is safer than automotible travel. *Flying*, June, 1944, pages 10, 23 (AC), 1 illus.

Landing Puddles or Airports. Willy Ley. Briefly comparing the flying boat and land-based airplane on points of serviceability, efficiency, production, and safety, the writer indicates that the flying boat is more suitable for certain conditions and has an added advantage in the type of landing site it requires. He claims that construction and maintenance costs of marine sites are cheaper than those of airports and that the number of marine sites available in the United States is large. The water bases are indicated to be as desirable for private airplanes as for large transports, with the pontoon-equipped Fairchild cited as an example. It is the writer's opinion that flying boats, even at a size still inferior to comparable landplanes on a weight basis, are more versatile than the landplanes because of the availability and cheapness of water bases. *Air News*, June, 1944, pages 18, 19, 6 illus.

Airplane Descriptions

Spitfire Twelve. A summary of the data which have been released on the Spitfire XII. Powered by the Rolls-Royce Griffon, this version of the Spitfire was developed for low-altitude performance. Modifications and changes are reported in its fuselage, engine mounting, wings, rudder, cockpit cover, engine cowling, and tail wheel. The article also reviews features of the Griffon engine which contribute to the performance of the plane. *Flight*, April 20, 1944, pages 414, 415, 4 illus.

Siebel Si 204. A brief description is given of the Siebel Si 204, which, it is noted, was designed in 1941 to meet two urgent requirements of the Luftwaffe. These were the need for an advanced trainer and for a lighter type of transport aircraft. This monoplane is of the low-wing cantilever type with twin fins and rudders and an undercarriage that retracts into the engine nacelles. Power is furnished by two Argus As 411 twelve-cylinder, inverted V-type, air-cooled engines. Each engine drives a two-blade variable-speed propeller. The cruising speed of the plane is 210 m.p.h. and the maximum speed is 225 m.p.h. The two versions of the plane which have been developed are described. *Flight*, April 6, 1944, pages 369, 370, 3 illus.

New Cargo Plane is Time Saver; Freight Units Loaded by Hoists. This article describes a new type of cargo plane, the principal features of which are a removable cargo unit and an inverted tail group. The plane is designed to expedite the handling of air-transport freight. The inverted tail group is said to provide flight advantages and to aid in ground handling. *Air Transportation*, May, 1944, pages 20, 21, 6 illus.

Aeroplanes of the Rumanian Air Force. A review of the history of the Rumanian Air Force is accompanied by illustrations and specifications of several of the service aircraft used by that country. The article also describes the development of the aircraft industry in Rumania and its present operations. Several of the current operational types are imported from Germany, France, and Italy; others are manufactured by the Rumanian aircraft firm whose initials, I.A.R., are used to designate all the airplanes and engines produced by the company's design staff. The specifications give the name of the manufacturer, the duty for which the plane is designed, the engine, dimensions and weights of the plane, and its performance. There is also a list of present aircraft types in service with the Rumanian Air Force, classified under the type of service for which they are used. *Aeroplane Spotter*, April 20, 1944, pages 90, 91, 8 illus.

Preview of Postwar Transports. Some brief specifications are given of three transport planes now being developed for postwar service. The three are Consolidated Vultee's Model 39, the Douglas DC-4, and the Martin Mars. Details of the interiors of the three planes supplement information about the design and performance of each. *Western Flying*, May, 1944, pages 46–48, 8 illus.; "Consolidated's Model 39 Transport," *Aero Digest*, May 1, 1944, pages 78, 79, 4 illus.

Japanese Fighter Design. Martin Caidin. A survey of Japanese naval and military fighter airplanes. Characteristics and design features of the following planes are discussed: Mitsubishi S-001 Zeke, S-002 Hap, S-003 Tony, SHS-00 floatplane, and other variations of the Zero type for the army and navy; Nagoya S-00 and S-001, Nakajima S-01, "Tojo," and SKT-97; the Suzukaze 20 and AT-27, and Kawasaki S-97. Descriptions given of the Mitsubishi Zeros are more complete than those of the other planes. *Air News*, June, 1944, pages 24–26, 11 illus.

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Airports and Airfields

Hangar Roof Runway Terminal Airport. Details are given of an airport design conceived by Lyman S. Peck and intended principally for use by transcontinental and inter-continental services. The outstanding design feature of the Hangar Roof Runway Terminal Airport consists of runways situated 55 ft. above the ground level on roofs of hangars. Advantages of the additional altitude in the landing and take-off of a plane are demonstrated. Among other features of the design are provisions for airplane-arresting devices to prevent the planes from running off the end of the elevated structure should an airplane's brakes fail to function on landing; arresting devices, located 25 ft. in from the parapet walls on both sides of each runway to prevent a plane from running off the side of the runway; and flying-boat and seaplane accommodations.

As described and illustrated, this airport design calls for four runways, each 250 by 5,280 ft. Hangar and shop space covers 5,700,000 sq.ft. and the passenger terminal 300,000 sq.ft. Each of the 54 hangars can accommodate four airplanes with a wing spread of 150 ft., or two airplanes with a spread of 300 ft. and an overall length not exceeding 150 ft. An electrically operated elevator or lift in each terminal building raises or lowers planes to or from the runway level. An airplane elevator is installed in each of the eight sections of a taxiway that connects the ends of all runways on the same level.

Based on anticipated postwar costs of labor and materials, the estimated cost of this airport is $50,000,000. A breakdown of the computation of costs for various components is shown. *Aero Digest*, May 1, 1944, pages 56–58, 5 illus.

Commercial Air Center. Lt. (j.g.) L. W. Burton, Jr. This article discusses the development of air centers for postwar civil aviation, designed to eliminate traffic congestion and combine safety with simplicity. The progress that has already been made in this direction is referred to, and particulars are given of the Miami Aviation Center now under construction. Illustrations show a twin-field arrangement and a "pin wheel" design, which can be set up on a mile-square grass field with sod runways for a minimum cost. *Air Trails*, July, 1944, pages 28, 29, 100, 3 illus.

The Airport Terminal Problem. Albert F. Heino. Three principal methods of central terminal design are described, illustrated, and discussed. Plan 1 shows the "production line" technique as it might be applied to an air terminal. The planes are processed on a line running around the terminal from unloading to loading positions. As traffic increases it is necessary to parallel the operation by routing several planes abreast around the terminal at peak hours. Plan 2 shows the development of present terminals into a system of docks providing covered passage from the terminal to the plane berth. It is noted that if permanent docks are assigned to individual air lines the plan approaches the unit-terminal design except that it operates as a central terminal. Plan 3 shows a type of central terminal which is stated to have received much study as a means of bringing the plane berths in close to the terminal. It results in a series of projecting piers or "fingers" arranged with the plane berths on both sides.

Other sections of the article discuss the case for the decentralized-terminal plan, the unit air-line terminal, the public center, and the development of the unit terminal as it affects the private flier and the fixed-base operator. *Aviation Maintenance*, June, 1944, pages 46–52, 156, 12 illus.

Air Cargo for the Far Corners of the Earth. George Herrick. A description is given of the Air Service Command's new freight terminal at Newark Airport, which is designed for heavy air-cargo traffic. It is stated that air-line engineers should find in it useful ideas for inclusion in their postwar cargo-handling plans. *Air Transport*, May, 1944, pages 37–39, 13 illus.

Town Planning and Air Transport. R. H. S. Phillips. Suggestions are furnished for the incorporation of air-transport facilities in towns planning to meet postwar expansion in Great Britain. The writer discusses seaplane bases, access to air stations, and the location of airports. References on the subject are included. *Aircraft Engineering*, April, 1944, pages 97–99, 2 illus.

Profit Possibilities for Airport Terminals. Dudley M. Steele. Advice is offered on how to merchandise postwar airports and make them profitable enterprises. Suggestions for potential sources of revenue include a hotel, garage, gasoline service station for automobiles, parking lots, spectator ramps, sky-room dining room, sale of aviation gasoline and oil, gift and novelty shops, barber shop, bank and post-office branches, drug store, bowling alleys and swimming pools, newsreel theater, and sale of electric power. Other suggestions concern limiting the number of concessions, making intelligent leases with government agencies, charging for telegraphic facilities, public telephones, franchise fees, reasonable assessment of rentals, and drive-your-self cars. *Southern Flight*, May, 1944, pages 36, 37, 64, 8 illus.

Observations on Airport Construction. Bernard E. Gray. Indicating the effect of increasing airplane-wheel loads upon the construction of asphaltic runways, the first article in this series investigates the factors to be considered in meeting this problem. The considerations discussed are impact, repetition of load, general location and layout, soil, bearing power of the subgrade, and drainage methods. Examination of the last factor includes a description of a French drainage system. Requirements for a modern airport surface are outlined, and a table of the wheel and unit loads used at present for designing airports is shown. *Flying*, June, 1944, pages 15–18, 22-(AC), 7 illus.

Maintenance of Airport Cone Mounted Lights. A summary of information about the installation and upkeep of cone-mounted lights for airports. Illustrations show the design of the lights, methods of mounting them, and repair procedures. *Aviation Maintenance*, June, 1944, pages 59–61, 154, 156, 11 illus.

Air Hub of Americas. Chick Edwards. Some notes on the development of the two major airports in New Orleans. The establishment and growth of Callender and Moisant airports are reviewed. *Airlanes*, May, 1944, page 17.

Caution Urged in U.S. Airport Expansion. E. J. Foley. The writer emphasizes that an airport need not be a profit-making venture to be successful. It is pointed out that an airport brings some intangible return to a community and, in many cases, these intangibles are important items. The better use of airport facilities is urged. It is stated that too many planners are interested only in expansion. *American Aviation*, May 15, 1944, pages 62, 64, 1 illus.

Armament

Forging and Fabricating 1000 Pound Semi-Armor Piercing Bomb. Gerald Eldridge Stedman. How 1,000-lb. semiarmor piercing bombs are made at a plant of The Darby Corporation is described. The sequence of operations in the processing of these bombs is outlined. Sections of the article describe the raw material from which the bombs are made, the forge furnace, forging operations, the way the handling lugs are welded on, and inspection and finishing operations. *Steel Processing*, May, 1944, pages 285–288, 324, 6 illus.

Chemical Warfare Service Doing Important Job. The work of the Chemical Warfare Service in supplying incendiary items to the British Army is noted. Information is given about the appearance, composition, and action of several incendiary types of bombs. The types include magnesium, thermite, oil, and phosphorus bombs; bomb clusters; and aimable clusters. Comments are also made on the factories that are producing incendiary bombs. *Commercial Aviation*, April, 1944, pages 77, 80, 82, 5 illus.

Bomb Report. Andrew R. Boone. The destructive power of bombs is discussed. Some of the types of bombs developed by the Ordnance

Department in cooperation with the Army Air Forces for destroying enemy factories are described and illustrated. *Air Trails*, July, 1944, pages 36, 37, 83–85, 2 illus.

Avigation

Groundwork for a New Interpretation of the Problem of Air Navigation. Part I. Tappan Collins. The first of a series of articles in which the writer suggests a new system of instrumentation for air navigation. His theories of the kind of system that is needed are based on the concept of air navigation as a problem of compound rotations. Analyzing the inadequacies of current instruments in directly supplying the data on present direction of motion, present ground speed, and the remaining distance to be flown, he indicates the advantages of a single dial-type instrument that would interpret the direction-speed vector and its relation to the planned flight against a simple constant background. *Aero Digest*, May 15, 1944, pages 54, 55, 2 illus.

Companies

From Crates to Carriers. Victor Boesen. An extensive article on the history of Western Air Lines, Inc. The growth of the company is traced from its inception in 1926, under the name of Western Air Express, up to the present. Featured in the account are data on Western's equipment and facilities; executives and pilots; expansion of routes; innovation of passenger services; establishment of first all-air coast-to-coast operation; and development of technical, communications, and weather-forecasting improvements. Some other milestones in its history mentioned include backing received from the Guggenheim fund, tie-up with railroad service, cancellation of mail contracts, and changes in corporate titles. *Skyways*, June, 1944, pages 32, 33, 50, 52, 60, 62, 66, 86, 12 illus.

Gray Rocks Air Line. Tracy S. Ludington. The 25-year history of the Gray Rocks Air Service is reviewed and possibilities of future development are envisioned. The route of this small air line is from Montreal to the Laurentian Mountains in Canada. *Canadian Aviation*, May, 1944, pages 74, 76, 2 illus.

Design

Vibration of a Truncated Wedge. J. F. C. Conn. This paper presents a mathematical investigation of the modes of vibration of a truncated wedge—that is, a cantilever of rectangular plan form and linear thickness distribution, fixed at the thicker end. Each mode of vibration is considered independently. Solutions are obtained for the differential equations of motion, from which expressions for the natural frequencies of vibration are obtained. The effects of damping and rotary inertia in flexural vibration are not taken into consideration. It is explained that the solution for torsional vibration is valid only in those cases where the cross sections are relatively thin in comparison with the width. It is stated that the results are of some practical utility in estimating the vibration frequencies of screw-propeller blades. *Aircraft Engineering*, April, 1944, pages 103–105, 1 illus.

DeHavilland "Mosquito." Part I. Chester S. Ricker. The beginning of a two-part study of the Mosquito's design and construction. In Part I, the engineering breakdown of this all-wood fighter-bomber features the details of its fuselage, bulkheads, main wing, double skin on wing, wing ribs, and leading edge. Schematic drawings of the several parts are included, as well as tables of fundamental design information and airfoil data. This design analysis of the Mosquito is the sixth in a series of articles detailing the design and construction of various airplanes. *Aviation*, May, 1944, pages 127–140, 31 illus.

Jets Versus Airscrews. L. G. Fairhurst. Some of the limitations of jet propulsion are noted, and ways in which the propeller can help the jet are indicated. It is stated that for some years hence transoceanic aircraft in service below 30,000 ft. will be most economically operated by reciprocating engines and airscrews. If the trend of civil transport should be toward speeds of 400–500 m.p.h. at altitudes of about 40,000 ft., it will remain a matter of speculation as to which form of propulsion will give the most economical operation. *Flight*, April 6, 1944, page 362.

Post-War Design Prospects. By Ariel. A projected design for a post-war commercial freighter and passenger aircraft is described. The factor that influences the design is the improvement of pay-load potential over that of current airplanes through the reduction of drag, the decrease of structural weight, and the addition of cubic capacity. Advantages of a flying-wing type of structure for this purpose is stressed.

The described aircraft is pictured as an all-wing type with wing sections thickened to about 20 per cent of the wing chord; this affords greater strength and increased cubic capacity for stowage purposes. The body is divided into an upper and lower deck for passengers, with the upper deck extending for a considerable distance into the wing on each side. With an anticipated all-up weight of approximately 150 tons, the cruising speed of this plane is expected to be around 300–325 m.p.h. *Aeronautics*, May, 1944, pages 44–46, 3 illus.

The Fairey Barracuda. B. J. Hurren. Some of the difficulties that had to be overcome in the design of the Fairey Barracuda are outlined. Reviewing adverse criticisms directed against this naval aircraft in the past, the writer cites its record of performance, which has vindicated it. Among the design problems discussed are those of forward vision, of wing folding, and of providing a monoplane that would not build up excessive speed in a dive. In an editorial addition to the article, attention is called to some noteworthy features of the Barracuda. *Flight*, April 20, 1944, pages 416–419, 8 illus.; *The Aeroplane*, April 14, 1944, pages 404, 405, 414, 415, 6 illus.

An Application of Engineering Design Simplification. James A. Broadston. It is pointed out that the designing of machine parts for aircraft offers a distinct challenge to engineers. By cultivating an inquiring mental attitude, the design of parts can be improved. Seven fundamental objectives the engineer should keep in mind when making a study of new design are listed. To illustrate the way design problems are solved the writer describes how a shuttle valve was redesigned to eliminate six of the eleven machined parts in the prototype. *Industrial Aviation*, June, 1944, pages 21–25, 68, 13 illus.

Some time ago a group of distinguished scientists and engineers designed, on paper, a most remarkable new instrument that could be invaluable in a certain war activity. But when the final calculations had been completed, it was realized that the device required a tube that not only had never been made, but perhaps never could be in adequate numbers.

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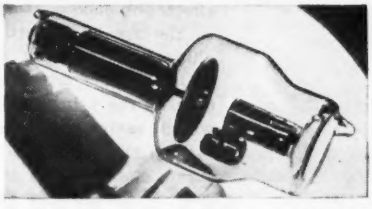

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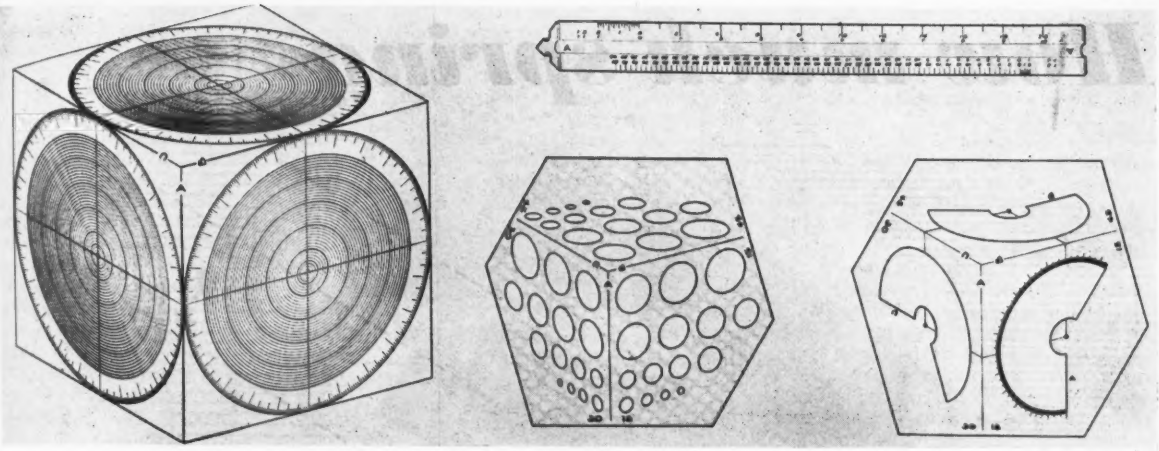

Four new trimetric drawing instruments developed at The Glenn L. Martin Company. *Left*, ellipse underlay; *top right*, trimetric scale; *bottom center*, ellipse template; *bottom right*, trimetric protractor. These instruments, used in conjunction with the Martin axonograph (*see* June, 1944, AERONAUTICAL ENGINEERING REVIEW, page 191), enable a conventional orthographic drawing to be translated into a scale trimetric drawing in from one-fifth to one-half the time that would normally be needed.

The trimetric underlay is designed for the construction of ellipses larger than 1 in. It consists of a trimetric cube on which ellipses have been concentrically arranged, eight to an inch, on each of the three planes or faces, with the three outer ellipses graduated in degrees. In use it is slipped under the drawing to the proper location and the desired size of ellipse is traced off. It can also be used on scale nontrimetric lines—that is, lines in the three principal trimetric planes not parallel to the coordinate axes—since a diameter drawn on a principal plane of the cube at any angular measurement is intersected "in scale" by the concentric ellipses.

The trimetric scale is a triangular instrument with an A-face, a B-face, and a C-face for measurements on the A, B, and C axes and all lines parallel to these axes. Each face is graduated in four scales—1:1, 1:2, 1:4, and 1:8—thus providing a single tool for the majority of fractional measurements. A similar instrument is graduated in the five scales—1:1, 1:10, 1:20, 1:30, and 1:60—for decimal measurements.

The trimetric template provides three series of ellipses, one for each of the three principal faces of the trimetric cube. The 15 ellipses in each series are in sizes from $^1/_8$ to 1 in., increasing in $^1/_{16}$-in. increments. The three parallel edges of the template are in exactly the same direction as the major axes of the ellipses, thus permitting the template to be placed on a horizontal reference line such as a T-square or drafting machine blade to draw in ellipses in exact position on the three principal planes of the trimetric cube.

The fourth instrument, the trimetric protractor, is similar to the ellipse template with outer shape and notation of the coordinate axes identical. Thus, for any one of the twelve trimetric positions, it can be used for angular measurement on the three principal planes of the cube. The degree graduations on this protractor are extended beyond the customary semicircle to one of the coordinate axes so as to provide both a reference axis, A, B, or C, and the major axes in each of the three principal planes.

Analytic Geometry For Speedier Wing Lofting. Part III. R. W. Feeny. The third part of a study of methods of applying analytic geometry to wing design gives the actual procedure involved in obtaining equations of canted structural members in the wing. Methods used to reach the desired answers easily are outlined. The writer explains some of the principles and theories used for determining equations of canted planes beginning with a definition of such an equation. Direction ratios, or direction numbers, are described as the ratio of the change in direction of a line with respect to its three given axes. How these are found is demonstrated through the use of examples; other examples are worked out to show the derivation of equations of canted planes in the wing. The next step is the application of the direction ratios of a line to the work of determining the true angle between any two lines in space. A general formula and examples are given. In a similar manner, it is shown how to find the true angle between two intersecting structural planes. Problems involving intersection of the lines and planes and intersections involving double canted stations are worked out mathematically. The application of these mathematical treatments to the practical work of designing parts of the P-61 is given, *Aviation*, May, 1944, pages 162–164, 269, 271, 5 illus.

Mosquito Genetics. The history of the de Havilland Mosquito's inception and development is traced. Emphasis is placed on the versatility of the plane and its efficient performance in all versions. The list of Mosquito applications includes the following: long-range day fighter; night interceptor-fighter; night and day intruder-fighter and fighter-bomber; low-, medium-, and high-attack day and night bomber; special bomber carrying 4,000-lb. "block buster"; pathfinder; long-range photographic reconnaissance aircraft; and high-speed, long-range transport. *Flight*, April 20, 1944, pages 423–427,13 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Vibrations in Aircraft. Part III. R. G. Manley. This third article of a series discusses the sources of forced vibrations. Consideration is given to periodically varying forces originating in and around the power plant, as well as to static, dynamic, and aerodynamic unbalance in propellers. Inertia effects brought about by the reciprocation of the piston and connecting rod are indicated. It is explained that if the connecting rods were of great length the motion of the piston would be nearly sinusoidal. The distortion from the pure sine-wave form, caused by the fact that in practice the connecting rod is only three or four times as long as the crank, is illustrated. How the resultant forces and moments acting on the engine-mass depend on the geometrical arrangement of the cylinders and the crankshaft is described and deformation of the crankshaft is discussed. It is noted that torsional vibration probably still remains the most important type of vibration in aircraft power plants. Methods of reducing torsional vibration are outlined. *Aircraft Engineering*, April, 1944, pages 100–102, 8 illus.

Some Present Nonlinear Problems of the Electrical and Aeronautical Industries. Ernest G. Keller. In this paper a number of representative nonlinear systems, which illustrate certain enumerated principles, are

How much spring

in a spring washer?

• **Only two** things count in any spring,—the **power** and the **distance in range** of its **live** spring action.

All of your bolted assemblies will **loosen** in a short time unless you use a spring washer to compensate for bolt stretch and for the inevitable wear and abrasion of **all** parts of the assembly.

Though the heat treated bolt may stretch only a little, all other parts will loosen because of the lapping of metal on metal, burrs and flares, and the pulverizing of paint, scale and rust.

If you want your assemblies to stay tight longer you must use a big powerful spring washer. There is no substitute as economical. A short range multi-toothed washer has far less power and range of spring action. A fixed nut has none. And even if the nut never budges on its bolt, the **other** parts of almost all vibrating assemblies loosen inevitably.

Kantlinks—the big live widely expanding spring washers—keep on expanding and compensating for whatever wear occurs. Kantlinks **hold** bolted parts tight longer than any other device made.

Let us send you samples,—send details of your application, test and compare them on the same job with **any** type of nut, or with any other type of washer. Kantlinks can't lose a real test. Try them for efficiency, economy and real safety.

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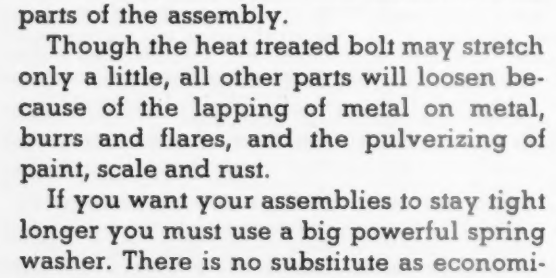

Note the long range of live spring action. The nut never turned, but parts wore or stretched. The assembly would have loosened except for the wide range of a Kantlink.

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treated. It is explained that these systems are either original or else of recent date. Some of them pertain to electrical manufacturing; others to aircraft development. Of the seven problems treated in the paper, one—a nonlinear problem of two oleo-pneumatically coupled masses, one of which is subject to impact—is directly applicable to aeronautical engineering. Although the derivation of the equations of a system is often more important than the solution, none of the equations considered is derived in the paper. References are given to articles in which some of the systems are derived. The derivations of the remaining ones are not given for military reasons. *Quarterly of Applied Mathematics*, April, 1944, pages 72–86, 13 illus.

The Tandem Monoplane. George H. Miles. The chief designer of Miles Aircraft, Ltd., suggests a reversed tandem-wing design embodying certain advantages not possessed by orthodox, tailless, and tail-first aircraft types. Stating that orthodox aircraft are limited by their sensitivity to small changes in the position of the center of gravity and by inadequacies with regard to differing load distributions, he also calls attention to the main limitations of tail-first and tailless airplanes. The features of the proposed design are then described and its applications for military and civil use are indicated. A suggestion is also made that the name "Libellula" be applied to all aircraft in the reversed tandem-wing classification. *Flight*, April 27, 1944, pages 444–447, 5 illus.

Mr. Designer . . . Let's Be Practical. Robert J. Whittier. A service mechanic offers a number of suggestions for improving the design of postwar private airplanes from the standpoint of servicing and maintenance. His criticism include reference to nonswiveling tailwheels, inadequate provisions for pushing planes about, and the projection of wing-tip navigation lights from the tip bow. Among his suggestions are the following: provision for sufficient ground clearance for the wheel pants, to allow upward tilting of the plane in storage; device for removing spinner readily; a seal to prevent gasoline from leaking; one quick-action fastener for holding an inspection plate instead of a half dozen separate screws; lifting and hoisting devices; tie-down loops and control locks. Other specific design improvements that he indicates as being necessary are relative to sediment bowls and strainers in fuel systems, gasoline and oil-tank caps, oil-tank filler openings, battery installations, floorboards, soundproofing, carburetor and cabin heaters, engine cowlings and baffles, cabin interiors, instrument-panel fronts, instruments, dual control connections, engine and accessory controls, brakes, and the full-swiveling tailwheel unit. *Air Pilot and Technician*, May, 1944, pages 4–7, 8 illus.

Graphical Aids for Designer and Draftsman. Harold C. Martin. In this paper on graphical solutions of aircraft structural problems several common design problems are examined with a view toward their simplification. Design charts, intended to solve the equations involved, are next developed. Illustrative problems in each case indicate how simply problems can be solved by means of these charts. *The Draftsman*, May, 1944, pages 11–14, 26, 11 illus.

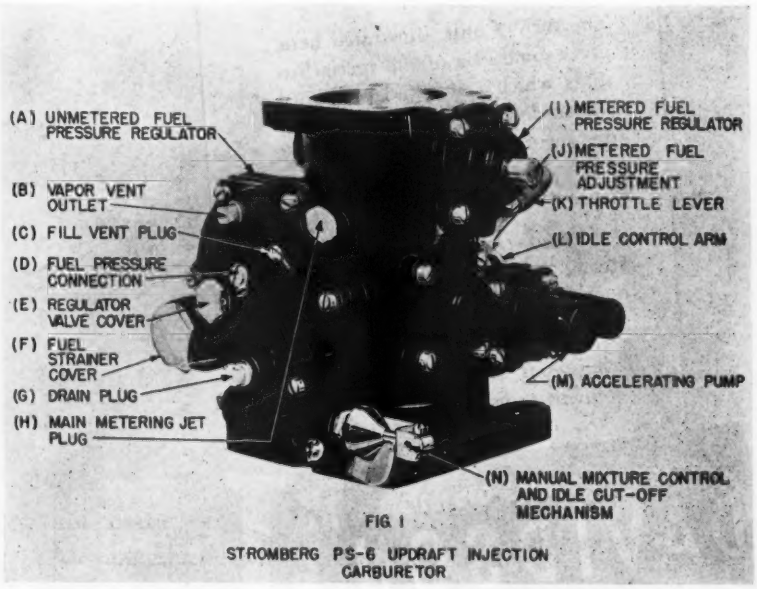
Electrical Equipment

Effect of Altitude on Electrical Insulation. Part II. Leo J. Berberich, Arthur M. Stiles, Graham L. Moses, and Cyril G. Veinott. The second part of this article about electrical insulation reports the results of an investigation of surface flashover to determine the requirements for clearances in aircraft electrical apparatus rated up to 600 volts and for use at altitudes up to 65,000 ft. Test results for various insulating materials in dry air are tabulated with respect to flashover voltages. Although no significant differences are apparent among the various materials, it is noted that in nearly all cases the a.c. peak values are somewhat higher than the d.c. values. Several indications are cited to show that surface flashover under dry conditions is influenced primarily by the density of the air surrounding the material under test. Breakdown tests with moisture-laden air are described and results are plotted and compared with data for dry-air conditions. The effects of snow or ice particles are reported and comments are made concerning the conclusions to be drawn from the experiments. The properties of the various materials tested are discussed, as well as the theories that account for the variations in the results obtained.

In order to obtain comparisons between tests made on laboratory samples and those made on a particular piece of apparatus, a brush-holder assembly for a 28-volt aircraft generator was investigated. This experiment is described. It is noted that there is a similarity in the conditions encountered by electrical apparatus used on railways and apparatus used in aircraft because both types are subjected to moisture, vibration, and dirt. Comparisons therefore are made of test results on these two classes of apparatus with respect to striking and creeping distances. The factors of safety are discussed. The results of all the tests are summarized in the six concluding paragraphs. *Aero Digest*, May 15, 1944, pages 122, 124, 126, 224, 225, 11 illus.

Engines

The Napier Sabre Engine. Part II. J. A. Oates. This installment reveals the procedures and equipment involved in the production of the six-throw crankshafts for the Napier Sabre engine, two of which are fitted to each engine. It also deals with the machining operations on the connecting rods and certain minor components. Beginning with the machining sequence, crankpin turning, and web operations, the study continues with particulars on drilling the journals, oil holes, bolt seats, grinding the web profile, drilling the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(C) FILL VENT PLUG
(D) FUEL PRESSURE CONNECTION
(E) REGULATOR VALVE COVER
(F) FUEL STRAINER COVER
(G) DRAIN PLUG
(H) MAIN METERING JET PLUG
(I) METERED FUEL PRESSURE REGULATOR
(J) METERED FUEL PRESSURE ADJUSTMENT
(K) THROTTLE LEVER
(L) IDLE CONTROL ARM
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FIG. 1

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Now in production for use in Army helicopter engines, this new PS model of the Bendix-Stromberg injection carburetor is said to maintain the ice-free characteristics of larger injection-carburetor types that equip the majority of Allied tactical aircraft. Incorporating basic design features called for by Army and Navy Specifications, the PS carburetor will be available to private plane engine builders after the war.

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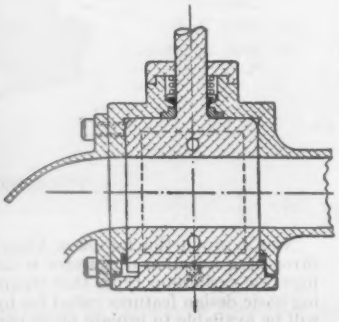

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flange, countersinking, and connecting rods. It then proceeds with information about the cap bolt holes, the sleeve, the sleeve ball, sleeve worm housing, and the impeller. The installment is concluded with production data on the propeller shaft cover, pantograph milling and grinding, and the gears. *Aircraft Production*, May, 1944, pages 230–240, 30 illus.

Synthetic Rubber Applications on Aircraft Engines. Gertrude H. Spremulli. A report of laboratory tests of synthetic-rubber vulcanizates typical of those available for aircraft. The tests revealed the following points: (1) Synthetic rubber stocks vary greatly both in percentages and rates of weight loss during aging at 212°F. (2) Changes in physical properties of the stocks tested during oil aging are a function of both the temperature of testing and of the aniline point of the oil. (3) Gum extracted by aromatic fuel from synthetic rubber stocks varies with the temperature and, to a much smaller extent, with the length of time of extraction. (4) X-Ray diffraction analysis provides a means of identifying some of the polymers and crystalline fillers in a stock and also yields information regarding the particle size of the fillers present. *SAE Journal*, June, 1944, pages 255–275, 280 (Transactions), 45 illus.

"Double Wasp" Engine Now Mass Produced at Kansas City. Franklin M. Reck. A general account of how the R2800-C Double Wasp engine is manufactured at the Kansas City plant of Pratt & Whitney. The information given is mainly about the plant layout and the system of production flow. It includes descriptions of the assembly lines, conveyers, propeller-shaft department, equipment for machining front and rear aluminum crankcase sections, and the number of personnel. *Aero Digest*, May 15, 1944, pages 128, 130, 4 illus.

Power Unit Trends. Part V: Petrol Injection for Aircraft. This is the fifth installment of a series of articles discussing power units for transportation. Other installments have referred to surface vehicles. The writer discusses fuel injection for spark ignition engines. It is noted that the method usually employed is by injection under pressure through an atomizer directly into the cylinder or into the induction pipe adjacent to the inlet port. The equipment used for gasoline engines is similar to that employed for oil engines.

The injection method makes possible the use of gasolines of lower volatility developed with the object of reducing fire hazard. By dispensing with a carburetor, icing trouble is prevented. Other subjects discussed are fuel-injection timing, some of the difficulties experienced with fuel injection, and injection equipment. *Modern Transport*, April 22, 1944, page 7, 2 illus.

Ham and Eggs

THOUSANDS of deadly "eggs" have been laid at Adolph Hitler's doorstep by the American Air Forces — "eggs" that made possible our invasion of Europe. And now these "eggs" are falling again on Japan. In this advertisement we pay tribute to the Air Forces' personnel who operate the communication equipment of these aerial battleships — to the radio operators, many of them pre-war "hams."

Without radio — without these gallant flying "hams" — the daring coordination of thousands of planes would be impossible. These men are risking their lives daily so that American formations may communicate with each other, with the ground forces, and with their home bases.

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You may have to explain the picture to non-flyers. It is not an airplane. Capt. Albert "Pinky" Stainback, veteran United Air Lines pilot, is at the controls. He is approaching a Pacific Ocean port, with visibility zero...in the Link Trainer.

Stainback notes that his altitude is 1,800 feet, air speed 160 miles per hour. The rhythmic dot-dash of the Morse "A" in his earphones is merging smoothly now with the dash-dot of the "N" signal, which tells him he has found the "on-course" signal. He is on the beam.

Veteran "Pinky" Stainback knows he has to follow the beam to the "cone of silence," a dead spot of radio. When the beam hum dies off to silence and then resumes, he has his exact location with respect to the airport. Following instructions from the airport control tower, he now is prepared to land.

Thus United Air Lines pilots practice approaches to distant ports in the Link—without leaving the ground! Thorough training in instrument flying has served United's pilots well—on 880 Pacific Ocean crossings in 1943, flying men and materials to faraway fronts. United crews also chalked up 2,400 military flights in the Western Hemisphere last year, besides flying the company's regular nation-wide passenger, mail and express schedules.

CAPT. STAINBACK tackles an instrument flying problem in the Link at United Air Lines' San Francisco terminal, under the watchful eye of Link Instructor Lyman Ellis.

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Flight Technique

Chandelle—The Boosted Turn. E. C. Bailly. An analysis of the chandelle, with some observations on how the student pilot can be made to understand it. Fundamentally, the chandelle is defined as a diving and climbing turn in which the climb and the turn are so excessive that they can be maintained for only a comparatively short period of time. A sequence for performing the maneuver is outlined. Overbanking is indicated as the mistake most commonly made by a student in doing chandelles. *Air Facts*, June, 1944, pages 77–82.

Flight Testing

Production Test Pilots. R. L. Stephens and Arthur E. Chapman. Flight testing and training of production test pilots is the subject of this article telling how the work is being carried out by Goodyear Aircraft Corporation at Akron, O. Flight testing is conducted on a quantity-production basis at Goodyear, and it is stated that success has been achieved through the careful selection and training of test pilots, the scientifically worked out flight-testing sequence, and the radio watch kept over each flight to safeguard the pilot and his plane. The work of the flight-test division is described in some detail. *Air Trails*, July, 1944, pages 34, 35, 56, 4 illus.

Gliding and Soaring

Gliders for Export. Erwin L. Schwatt. Beginning with a list of the general specifications to which seaplane gliders are built, a summary of the glider's tactical and strategic value, and a brief review of its history, this article goes on to differentiate between gliders built (by the Ventnor Boat & Plane Corp.) for domestic use and those built for foreign operation. It then describes the characteristics that distinguish the two export types, known as the Stork and the Pelican. Photographs illustrating the features that mark their departure from conventional designs are shown. *Aero Digest*, May 1, 1944, pages 109, 224, 4 illus.

Gliders Away! An article describing and illustrating the use of military gliders in warfare. In discussing developments in glider technique, particular attention is given to the system that enables powerful towplanes to pick up stationary fully loaded gliders from small fields without landing themselves. Reference is made to the CG-13A, a larger version of the CG-4A, capable of carrying more than 30 troopers or an equivalent load in equipment. *Army Ordnance*, May-June, 1944, pages 521–528, 15 illus.

A Training Glider for High Schools. Wesley B. Hammond. A high-school teacher's ideas regarding the theoretical design of a training glider suitable for "teen-age" boys are set forth in this article. It would be a single-place glider with enclosed fuselage of steel construction, high-position wood wing, and square-tipped tail surfaces. A single wheel in combination with a skid is advised. It is stated that the glider need not have a high gliding ratio, but that stability must be excellent. *Soaring*, November-December, 1943, page 9, 1 illus.

Rocket Power for Gliders. Cedric Giles. The installation of a number of small rocket-power units in the military glider to make it self-propelling whenever the need for tactical maneuvers arises is discussed. The advantages that might be gained by using rocket auxiliary power units instead of a small aircraft engine with propeller are noted. It is stated that with rocket units there would be less drag and the units would be less vulnerable to enemy attack.

Other possible glider developments and uses in the field of military aviation are suggested. These include ship-towed gliders instead of barrage balloons, possibly manned and armed for defense against enemy attack or for attacking submarines; armored gliders as "flying pillboxes"; composite aircraft consisting of a fighter plane attached beneath a large glider; and a pickaback glider, powered by jets, attached to an airplane for assistance in take-off. Experiments with rocket gliders are reviewed. *Astronautics*, March, 1944, pages 7–10, 16, 6 illus.

History

Call It Re-Conquest. Frank H. Ellis. An account of the First Alaska Air Expedition. Taking off from Mitchel Field, New York, on July 15, 1920, the flight went as far as Nome, Alaska, returning to New York on October 20 of the same year. The expedition's equipment is described; the participating flyers are listed; scheduled stops in the United States, Canada, and Alaska are noted; and events that happened along the way are related. *Canadian Aviation*, May, 1944, pages 47, 48, 94, 96, 4 illus.

Remember the "Nancies?" Lt. John B. Goodman. A historical review of the first successful transatlantic flight made by the NC-1, NC-3, and NC-4 Navy airplanes, which were among the forerunners of the large flying boats used in the present war. *U.S. Air Services*, May, 1944, pages 12–14, 42, 2 illus.

Icing

Ice. Part IV. Robert N. Buck. The concluding article in a series on flying during icing conditions and in snow. Part IV is concerned with problems involved in flying near, about, and through fronts, in some instances when the temperature is above freezing and in others when it is below freezing. Describing certain different sets of frontal conditions when ice may be encountered, the writer advises the pilot on what to do in each supposed case. He also tells how snow is formed and explains the effects of orographic lifting upon the formation of ice. *Air Facts*, June, 1944, pages 15–20.

Inspection

Statistical Control in the Inspection of Materials. Margaret Phipp. A brief outline is given of a system for keeping records of the inspection of special steels. The method of maintaining an inventory of stocks of materials is explained and the routine of making these records is described. Typical record cards are reproduced. *Aircraft Engineering*, April, 1944, page 119, 1 illus.

Factors Influencing the Interpretation of Aircraft X-Ray Films. Robert Taylor. Five reasons why X-ray inspection is considered essential for aircraft production are given. It is stated that the method saves machine- and man-hours, conserves critical material, speeds production, controls quality, and helps train workers. Some typical X-ray applications are described. The X-ray inspection and interpretation of welds is discussed. The writer explains how X-ray inspection augments other test procedures and also provides necessary information that can often be obtained in no other way. *Industrial Aviation*, June, 1944, pages 32–34, 5 illus.

Instruments

Electrical Instrument Overhaul. A description is given of electrical-instrument test panels and other equipment used in the shops of the Alameda Naval Air Station. The equipment was designed to provide overhaul personnel with compact test facilities. *Aviation Maintenance*, June, 1944, pages 56–58, 6 illus.

Calibration of Airspeed Meters. J. B. Rea. An explanation of how flight-test time may be reduced in the overall calibration of air-speed meters. Through demonstrations, which include the use of mathematical formulas, it is shown that once the position error curves have been established for any given airplane further flight-testing with trailing-bomb or speed-course methods should not be necessary in determining the overall calibration curves. Instead, the overall calibration curve may be obtained at any time by combining the position-error calibration curves with the latest equipment-error calibration. The major factors accounting for the difference between the airspeed meter reading and the true indicated air speed are described under the headings of instrument error, line error, pitot error, interference error, angle-of-attack error, and compressibility error. *Aero Digest*, May 15, 1944, pages 88, 90, 92, 5 illus.

Thermal Locators. Ralph O. Williams. This article was written to stimulate interest in the development of a practical thermal locator for sailplanes by outlining methods that have been suggested and on which some work has been done and possibly to

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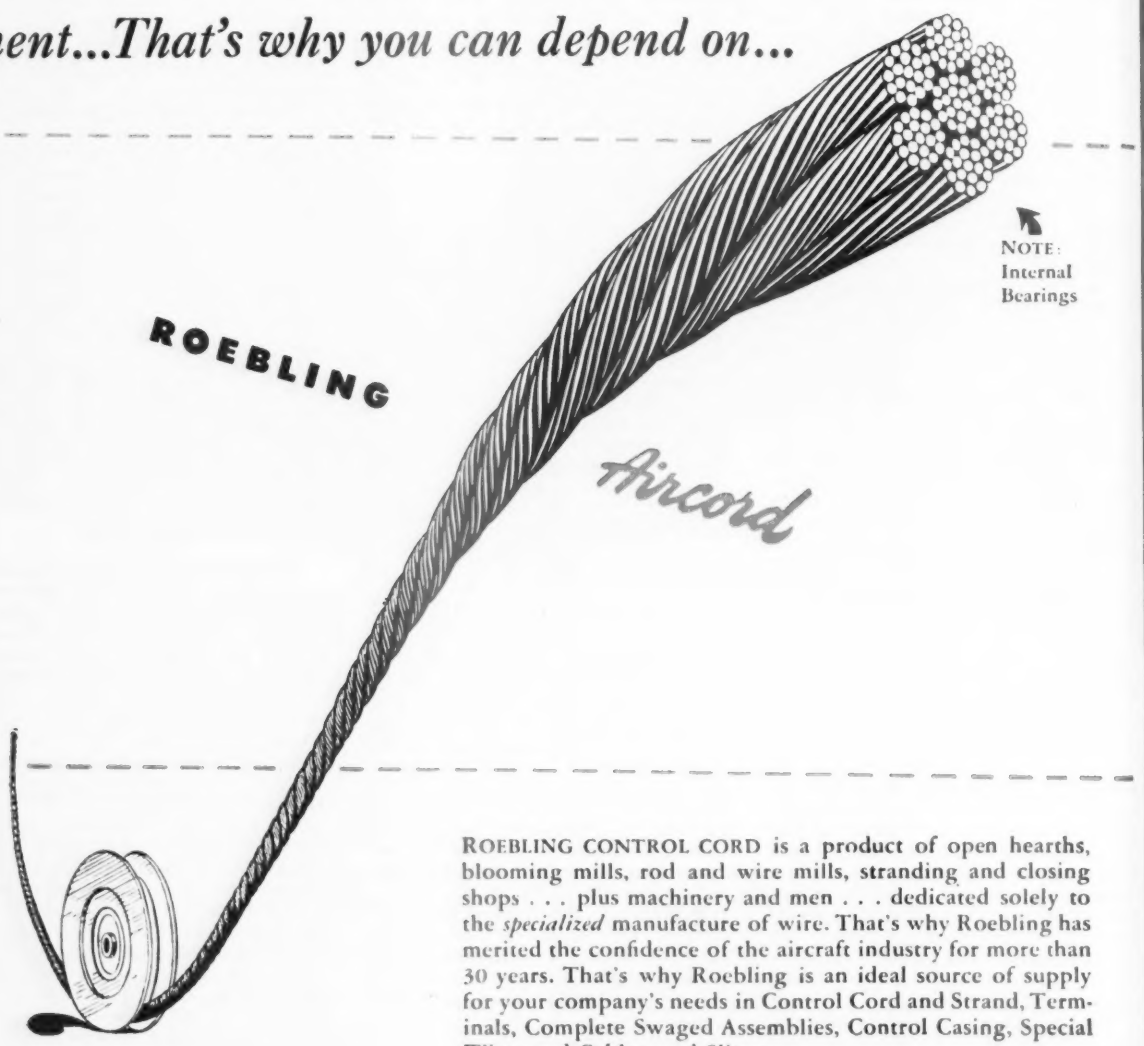

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open new channels of investigation. It is noted that it makes little difference whether the rising air currents are a succession of bubbles or fairly steady currents of warm air; the problem of detection is about the same. The scope and range of detection are discussed and eight proposed channels of investigation are listed and studied. *Gliding*, May, 1944, pages 8–10, 12, 14, 9 illus.

Pelorus Drift Sight. Ned G. Levien. A description is given of a pelorus drift sight for aircraft in which plastics are used for the head or sighting tube, the base, and the two dials. *Modern Plastics*, May, 1944, page 120, 1 illus.

Landing Gear

Float Repair Know-How. G. E. Nistal. Some standard and specialized maintenance procedures for float gear under wartime operating conditions are reviewed. Among the recommended and discussed practices are: frequent inspection of the lower portions of the bulkheads, as well as of the bottom of the pontoons; certain safeguards against the initiation and spread of corrosion; water tests for the general detection of leaks; the absolute avoidance of welding in any float-gear repairs; the employment of rivets for patches and the temporary substitution of screws if rivets are not available; removal of decks in top overhaul or major repairs; and methods of caring for struts. *Air Tech*, June, 1944, pages 31–34, 78, 22 illus.

Giant Aircraft Tires for the Lancaster. Some notes on the fabrication of landing-wheel and tail-wheel tires for Lancaster bombers and mailplanes. The procedures referred to are those employed by the Dunlop Tire and Rubber Goods Company, Ltd., of Canada. In addition to an outline of the main production processes, the article includes data relative to the construction of the tires and to the methods by which they are installed on the planes. Attention is called to the fact that a considerable quantity of synthetic rubber is incorporated in the tires. *Commercial Aviation*, April, 1944, pages 53, 54, 4 illus.

Lighter-Than-Air

London Express. Michael J. Kerwan. Some of the potentialities in the development of lighter-than-air craft for postwar long-range use are noted. While indicating certain problems involved in the development of commercial airplanes for this purpose, the writer recalls Germany's prewar experience in operating airships safely and profitably over transoceanic routes. Among the advantages of the lighter-than-air craft which he cites are: the requirement of fewer refuelling stops than for an airplane; the pick-up or drop-off of cargo and passengers without stopping; greater passenger comfort; and the United States' control of the helium supply. *Skyways*, June, 1944, pages 28–31, 72, 7 illus.; "We Need Airships," by Rear Adm. C. E. Rosendahl, *Collier's*, June 10, 1944, pages 14, 15, 44–46, 5 illus.

Maintenance

R.C.A.F. Attaining Maximum Serviceability Through Standardized Maintenance. Some figures are given to show the high serviceability record the Royal Canadian Air Force has attained for its planes. It is stated the record is not the result of departures from commonly accepted operational practices in servicing and repairing aircraft. Rather, success is attributed to standardized maintenance procedures that have been tested and proved for each type of aircraft; the establishment of time schedules for the completion of work; the employment of "saturation" crews to expedite servicing and repair within pre-established time limits; the basing of inspections upon predetermined time-expired schedules for planes; and the establishment of a smoothly functioning central control system. Maintenance and inspection schedules, as well as other features of the system, are described and illustrated. *Aviation Maintenance*, June, 1944, pages 39–46, 11 illus.

Brake and Wheel Maintenance. William S. Friedman. Definite procedures are outlined for the care of aircraft brakes and wheels during 25-hour, 50-hour, 100-hour, and 500-hour maintenance checks. Parts requiring special attention during these routines are pointed out, and advice is given on the causes of and cures for insufficient braking action, brake dragging, etc. The article also offers explanations of the functions of an airplane's brakes, the operating principle of the Goodyear disc-clutch brake, and the essential difference between mechanical and hydraulic brakes. *Air Tech*, June, 1944, pages 41–43, 78, 9 illus.

Hi Fellah! Joe Chase. The novice aviation mechanic is told how to go about cleaning an airplane. Notes are included on the parts of the airplane that require special attention, on what cleansing agents to use, and on certain practices to be avoided. *Air Facts*, June, 1944, pages 36–38.

Cleaning Technique for Rust-Proof Shipping and Storage. Herbert B. McKean. A discussion of the cleaning processes that should precede the application of preservatives in the corrosion-prevention care of metal parts. Two classes of cleaning—solvent and alkaline—are considered. In the solvent classification the procedures of immersion cleaning, spray cleaning, and vapor degreasing are described. In the alkaline classification data are given relative to immersion cleaning, spray cleaning, and electro-cleaning. *Flying*, June, 1944, pages AC-20, AC-21, AC-23, 5 illus.

Management

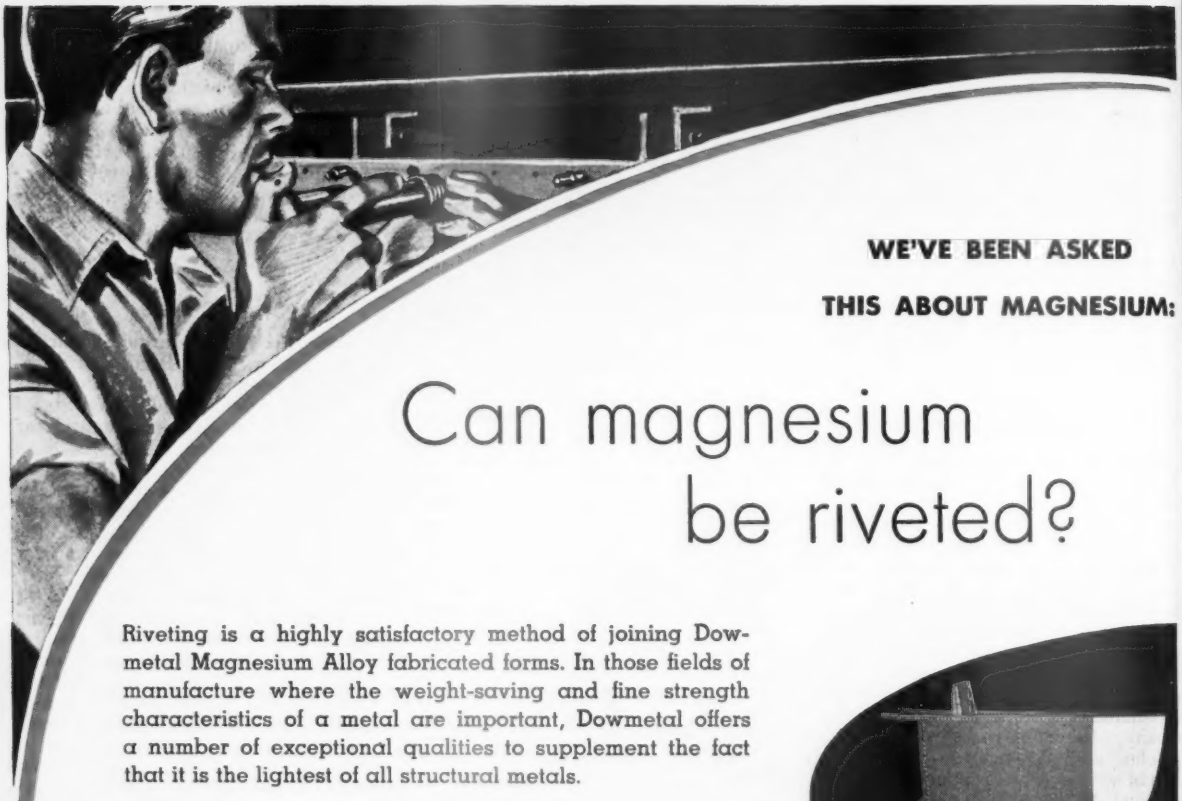
Saving Is Much More Than Salvage. E. J. Tangerman. It is stated that new concepts of conservation call for the more effective use of the three factors of industrial management—that is, man power, materials, and machines. The article describes how operations in aircraft plants can be improved through the cooperation of the special staff department and line committee. A chart shows a suggested set-up for an aircraft-plant conservation department. *Wings*, June, 1944, pages 1058–1060, 2 illus.

Marketing

Here Are Your Markets. Part I. John Foster, Jr. Results are reported of a survey to determine what states and regions of the United States present the best customer potential for aircraft distribution. With the data analyzed on a state-by-state and region-by-region basis, this first of three articles is concerned with the New England, Middle Atlantic, and South Atlantic states. Subsequent articles consider the East North Central, West North Central, East South Central, West South Central, Mountain, and Pacific regions. Information for each area includes the following: (1) total family population; (2) the percentage of the United States' family population contained in each state's and region's family population; (3) percentage of state and regional buying income, each related to the country as a whole; (4) percentage of United States retail sales within the buying power and buying habits of each state and region; (5) number of passenger automobiles registered; (6) number of passenger automobiles per 100 families; (7) number of aircraft registered as of October 1, 1941; (8) percentage of the country's aircraft registrations in each state and region; (9) number of nonair-line pilots registered as of October 1, 1941; (10) number of airports; (11) number of airports per 1,000 sq. mile; and (12) percentage of country's airports in each state and region.

For comparative purposes, a final market rating of Class A, B, C, D, or E is applied to each state. Market ratings for the nine regions list them first to ninth, in order of importance. All of the information is summarized in tabular form. Two of the conclusions brought out by the survey are that New York, Pennsylvania, and California are the best individual aircraft market states and that these three states are dominant in two of the three best market regions. *Aviation*, May, 1944, pages 110–115, 5 illus.

Keying Market Research to the Aircraft Industry. E. E. Lothrop. Suggested research procedures are outlined as a basis for postwar aircraft-merchandising programs. In the described methods of analyzing what planes can be sold and how many the market can absorb, three major outlets are considered—military, transport, and private. The ultimate military demand is noted as dependent upon five principal factors: first, length and severity of the war and, as a related



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factor, the number of planes surviving hostilities; second, decisiveness of the victory and peace terms; third, the role of the United States in international policing; fourth, new developments in military aircraft and the resulting obsolescence rate for existing craft; and fifth, public and Congressional reaction toward continued military spending.

For the transport market the researcher is advised to survey and analyze: (1) each domestic air-line operating company as to present equipment and projected expansion plans for equipment for the postwar period; (2) each American-operated international air-line company as to present equipment and projected expansion plans for the postwar period; (3) fixed-base operators as to present equipment and plans for contemplated expansion in the postwar period; and (4) foreign-operated air-lines for new equipment (contact their representatives in the United States as to plans for new equipment and for resumption and expansion of service in the postwar period).

The proposed planning procedure for the personal-plane market is outlined under steps of: (1) stripping away generalities that fail to suggest positive action; (2) reducing to their proper stature of importance and probability the various alarming aspects of the postwar aviation-manufacturing business which are amplified by some interests to make political issues; (3) collating for examination the specific conditions under which the individual business may expect to operate after the war; (4) distinguishing circumstances that can be controlled from those not susceptible to control, so that no time or energy are wasted on things that the individual alone cannot correct; (5) bringing into sharp perspective the conditions that are favorable and should be capitalized on, and those that are detrimental and should be counteracted. General factors that the personal-plane manufacturer must consider in postwar planning, as well as some broad objectives for all postwar aviation concerns, are listed. *Aviation*, May, 1944, pages 124, 255, 257, 259, 261, 263.

Materials

The N. E. Steels in the Post-War Era. Edwin F. Cone. Details are given of a survey conducted to obtain responsible opinions about the part National Emergency steels may play in industry after the war. A summary of conclusions is presented. *Metals and Alloys*, May, 1944, pages 1122–1128, 3 illus.

Magnesium. Samuel Crowther, 3rd. A record of the development of magnesium as a structural metal, together with a study of its aircraft applications. The characteristics of the metal are described and a summary of the alloys that are at present available for aircraft use is given. In addition to reviewing the past development and present applications of magnesium for airplanes, the writer makes some general predictions as to its utility in the future, stressing three points that will be of paramount importance to the aircraft industry: (1) In practically all types of aircraft applications magnesium will save anywhere from 5 per cent to 50 per cent in weight. (2) Magnesium offers a special advantage in pure monocoque construction because it makes possible the use of thicker skins without any increase in weight. (3) Desirable smooth, flush, and polished surfaces may be obtained through the use of magnesium. The article is supplemented by two tables, one of which lists the composition and characteristics of Dowmetal alloys, the other the relative weights of structural metals. *Air Tech*, June, 1944, pages 35–38, 74, 5 illus.

16:2—The Forgotten Stainless Steel. Max E. Tatman. The advantages of 16:2 type stainless steel (known as Type 431 commercially) over 18:8 stainless steel from a strength-weight ratio standpoint are outlined. It is noted that this is important in modern aircraft design, especially in the case of seaplanes. While at one time 16:2 alloy was not easy to melt, steel mills have overcome the difficulty by improved technique. Furthermore, heat-treating characteristics of the 16:2 type have now been more thoroughly investigated. Some of the improvements in 16:2 steel developed through recent research programs are indicated. *The Iron Age*, May 11, 1944, pages 70, 71, 160, 5 illus.

Plane Facts About Glass. This article deals with the processing of safety plate glass for aircraft applications, as carried out by Libbey-Owens-Ford. In addition to the fundamental operations in the fabrication of glass, it outlines methods of bending glass and combining it with plastics. Various uses of glass in airplanes are noted and the several aircraft activities in which Libby-Owens-Ford is engaged (involving both experimental projects and actual glass production) are mentioned. *Air Tech*, June, 1944, page 46.

Metallurgy

The Metallurgy of Modern Alloys. R. H. Harrington. This is the twelfth installment of an article on heat-treating processes for modern alloys. A possible concept of lattice strain as the pressure variable for metallic phase systems is offered. The discussion proceeds in sections titled: Pressure-Temperature-Concentration Planes Defining Phase Systems; Pressure-Temperature Diagrams for Some Pure Metals; Standard Temperature-Composition Diagram for the Copper-Tin System. Some practical applications of the concept are given. *Steel Processing*, May, 1944, pages 299–301, 4 illus.

Factors in the Development and Selection of High Temperature Alloys for Dynamic Loading. C. T. Evans, Jr. A description is given of some of the metallurgical and engineering factors that enter into the study of the special heat-resisting alloys for dynamic stressing which are used for aircraft superchargers, jet-propelled aircraft, gas turbines, and other purposes. Because specific composition or test information cannot be quoted, the descriptions are of a general nature. The writer discusses how heat-resisting alloys for dynamic stressing are being developed and tells of the problems involved in producing alloys that must withstand heavy loads for long periods of time at extremely high temperatures. *The Iron Age*, June 1, 1944, pages 38–41, 6 illus.

Refrigeration Retards Age Hardening of Aluminum Alloys. F. Keller. The use of refrigeration for preventing the age-hardening of heat-treated aluminum alloys for rivets and other aircraft parts is discussed. Advantages and techniques of the procedure are outlined. The proper temperatures for retarding age-hardening are considered. *Heating and Ventilating*, May, 1944, pages 49–52, 3 illus.

Aging and the Yield Point in Deep Drawing Steel Sheets. J. R. Low, Jr., and M. Gensamer. The fourth part of an article concerning the treatment of deep-drawing steel for strain-aging and yield point relates the results of experiments in putting carbon, nitrogen, and oxygen back into hydrogen-treated sheets. Each of these elements was introduced singly. The experiments are described under headings as follows: oxidation and carburization of wet-hydrogen-treated specimens; vacuum annealing of carburized specimens; nitriding of wet-hydrogen-treated specimens; and the vacuum annealing of nitrided specimens. *Steel Processing*, May, 1944, pages 303–306.

Heating Aluminum Billets by Low Frequency Induction. E. H. Plesset and J. R. Chadwick. It is explained that low-frequency induction heating may be applied advantageously to metals of low resistivity since the depth of heat generation is large and temperature gradients in complex shapes are avoided. Tests connected with the induction heating of spar caps are described. The tests indicated that 250 cycles is a satisfactory frequency for induction heating of spar caps prior to bending. From a standpoint of depth of generation of heat a low frequency—for example, 250 cycles—is superior to 9,600 cycles for the induction heating of large masses of aluminum such as spar-cap billets. The electrical and thermal characteristics of the combination of an induction coil and aluminum billet can be computed with better than qualitative accuracy. *The Iron Age*, June 1, 1944, pages 52–54, 3 illus.

Meteorology

Some Aspects of Stability Deduced from Vertical Wind Shear. Frank L. Martin. A study is made of stability relationships that are deducible from the variation of wind with height. The paper sets up what is offered as an easier construction of the stability field and also provides a simple quan-

titative means of obtaining the horizontal distribution of the mean lapse rate, based on consideration of the vertical wind shear. By means of an equation and from tabulated data in the paper the actual spacing of the isolines of the mean lapse rate between shear levels may be determined. The writer establishes two simple techniques for determining expected changes in the mean lapse rate at an air terminal for periods of from 6 to 12 hours. The changes in stability considered are those caused only by advection, neglecting such factors as convergence, radiation, evaporation, and condensation. In view of the approximations made in expressing derivatives in terms of finite difference, the specific numerical results are applicable only for short-term forecasts of approximately 12 hours. However, these results should prove to be of considerable value in forecasting the afternoon convective activity from the morning "pibal." This paper utilizes vector methods in the derivation and interpretation of the results. *The Bulletin of the American Meteorological Society*, March, 1944, pages 79–87, 3 illus.

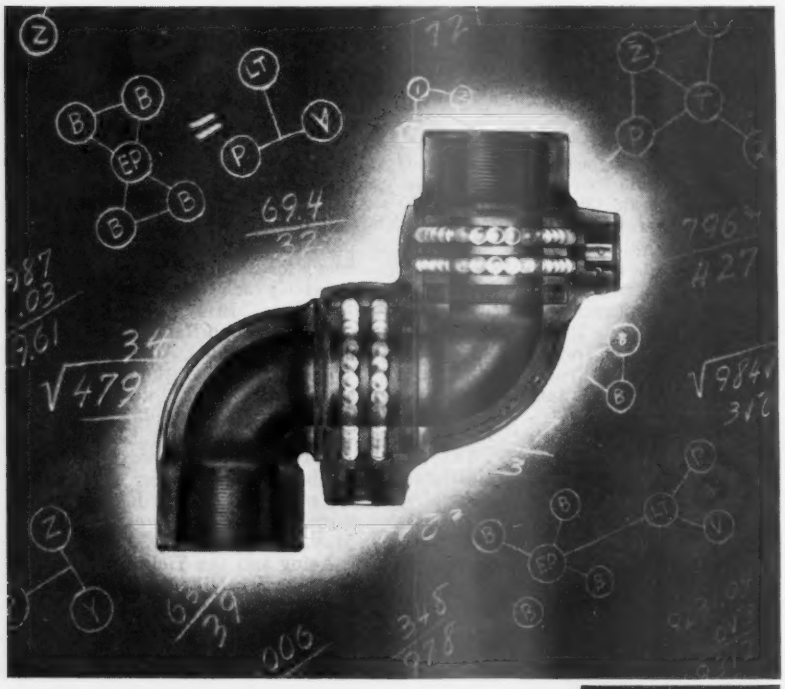
Atmospheric Turbulence. L. P. Harrison. The writer discusses the behavior of fall winds, which, it is stated, are usually generated in the neighborhood of high plateaus or mountain ranges covered with snow. Examples of such winds are given and phenomena that reveal their possible intensity are listed. Other special winds that occur in mountainous regions, including valley and mountain breezes, are discussed. *Soaring*, November-December, 1943, pages 7, 8.

A Weather Station for Every Airport. This article tells how to set up a privately owned meteorological observation center for small airports. It states that the weather forecaster for this type of station need not be a trained meteorologist and advises the amateur about the instruments that will be needed and the work performed by each instrument. Instruments indicated as necessary are the psychrometer, barometer, thermometer, anemometer, and wind vane. For more complete stations, the addition of a field altimeter, gas-filled balloons, and blank weather maps is suggested. *Air Pilot and Technician*, May, 1944, pages 14, 15, 40, 3 illus.

Military Aviation

This Air War is Becoming Complicated. Comdr. A. F. Bonnalie. A description is given of the different types of bombs and mines used in air war. The writer discusses mine planting, strategical and tactical bombing, and the various types of bombers used by the Allies. *U.S. Air Services*, May, 1944, pages 20, 22, 50, 1 illus.

RAF Planes Inventoried by Appendix "A." The system by which each British airplane is accompanied by its own inventory schedule, known as Appendix "A," is described. This appendix is a detailed list showing



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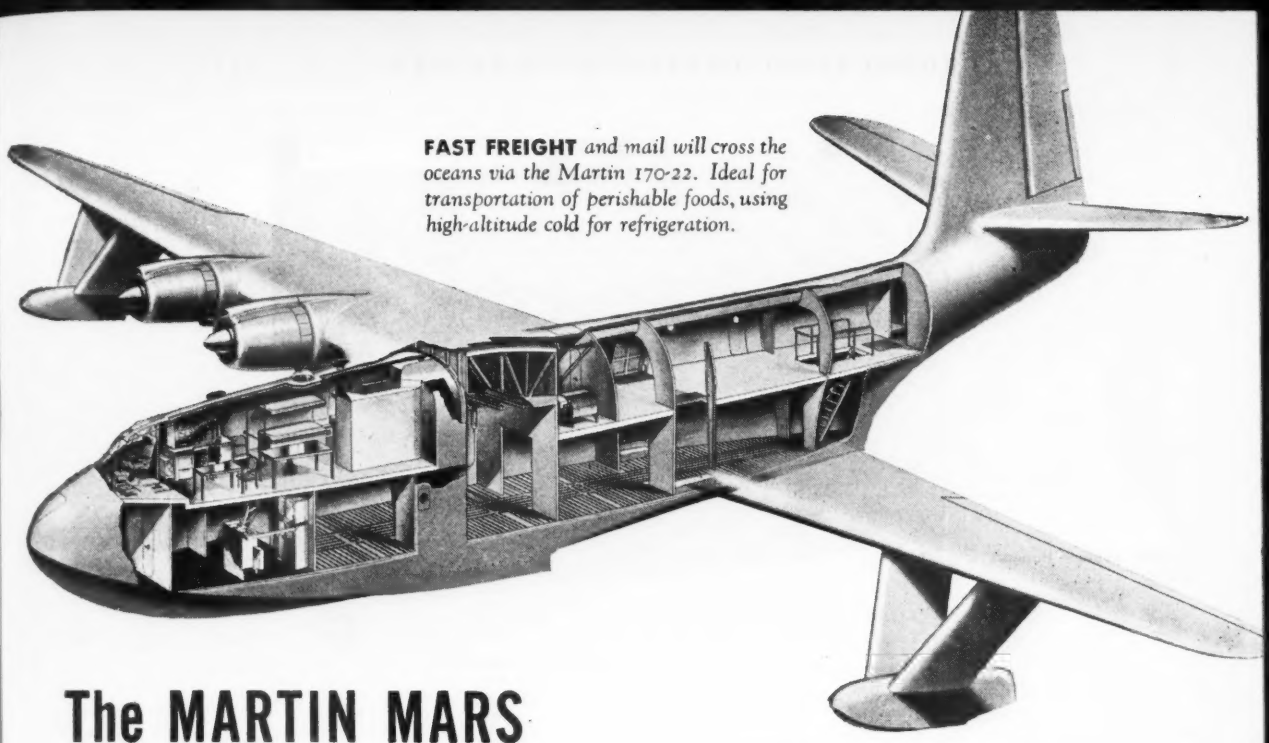

FAST FREIGHT *and mail will cross the oceans via the Martin 170-22. Ideal for transportation of perishable foods, using high-altitude cold for refrigeration.*

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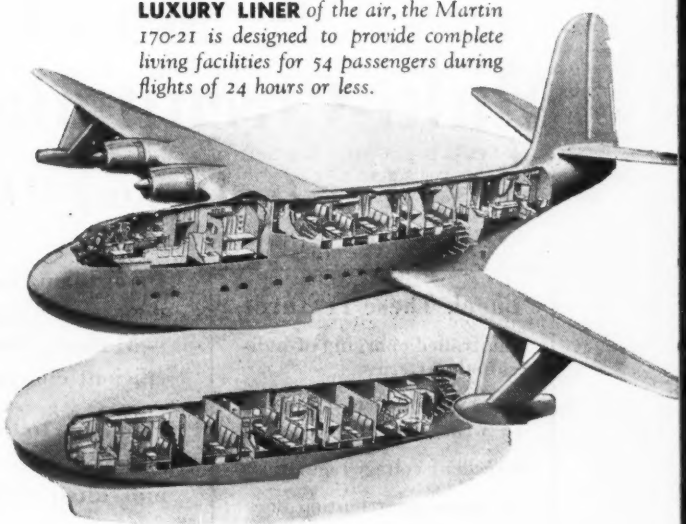

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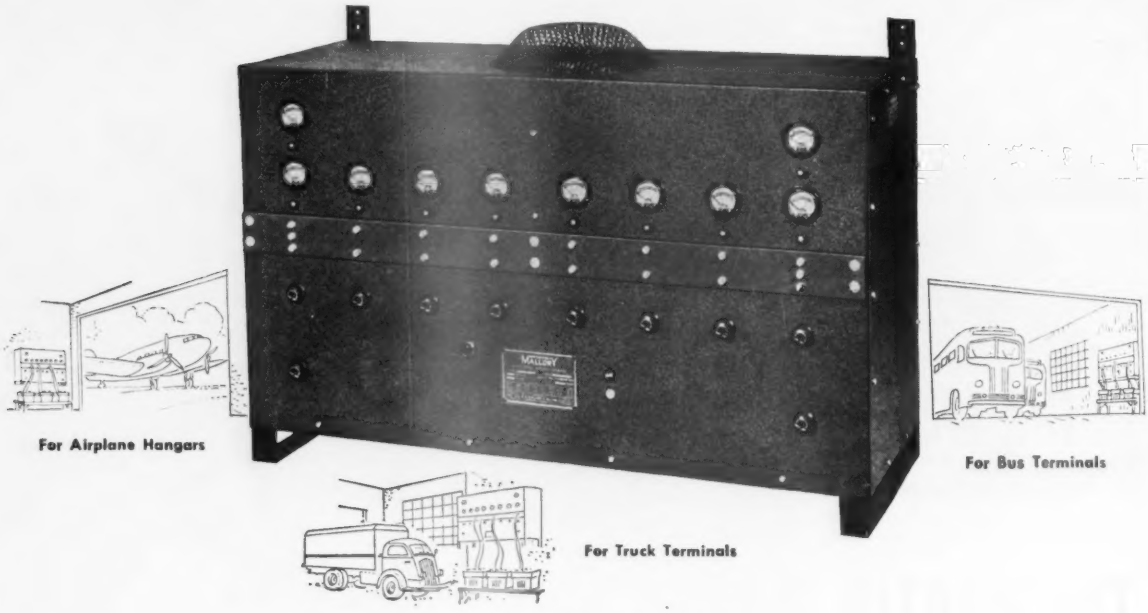

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what the equipment is, how it is identified, who put it on, where it came from, whether or not it is removable, and its weight. *Wings*, June, 1944, page 1061, 1 illus.

We've Got 'Em Covered. Arch Whitehouse. An account of how the Army Air Forces provide fighter cover for bomber groups. A chart shows the setup for a hypothetical raid on the German city of Stettin. As the fighters are unable to convoy the bombers all the way, they are operated in complicated shifts. *Mechanix Illustrated*, June, 1944, pages 42–44, 144–146, 148, 4 illus.

Naval Aviation

The AIR WAVES. Jay Allison. Indicating the demand for women with experience in various branches of aviation, this is a summary of new Naval regulations under which officer applicants for the Women's Naval Reserve may obtain commissions of a definite rank. Educational and experience requirements are listed and the rank to be awarded for each definite set of qualifications are noted. *Flying*, June, 1944, pages 57, 150, 2 illus.

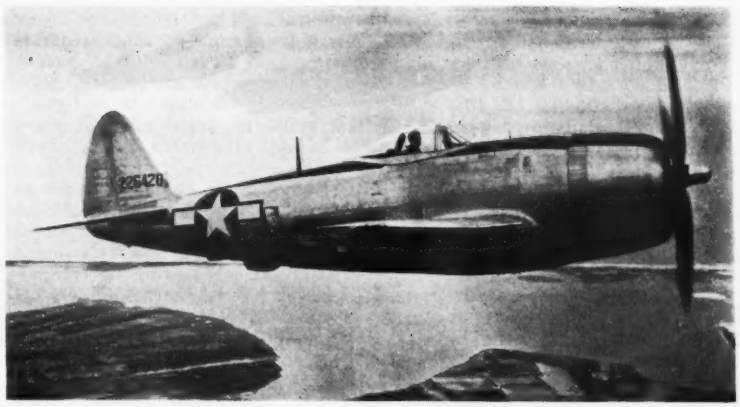
Paints and Coatings

Curtiss Commandos. H. W. Tompkins. A description is given of how Curtiss Commandos are spray-painted at the Buffalo plant of Curtiss-Wright. Operations are carried out in spray rooms provided with heated, doubly filtered air that is later exhausted through a water curtain. The air replacement system is described and the precautions taken to provide adequate illumination are outlined. *Heating and Ventilating*, May, 1944, pages 53–56, 10 illus.

Surface Protection of Aircraft Parts. V. S. Sorenson and S. G. Andrews. A description of the research program carried out by Lockheed Aircraft Corporation in an effort to solve finish problems arising from the increased use of low-carbon steels in place of nickel-bearing stainless steels. The growing importance of galvanic corrosion in aircraft construction is stressed and fundamental concepts of this type of corrosive attack are discussed. The results of investigations on comparative protection afforded by various combinations of phosphate treatments and additional coatings are given, and finishes now in use on various steel parts are listed. *The Iron Age*, May 18, 1944, pages 74–77.

Personalities

Three Airmen. John Hersey. Character sketches are given of Gen. James H. Doolittle, Col. Bernt Balchen, and Major Gen. Claire Chennault, accompanied by portraits of the three men by Tom Lea. The portraits were made by the artist in the course of a 20,800-mile air trip to China and back. Outstanding events in the careers of these three men are outlined and comments are made about their achievements. *Life*, May 27, 1944, pages 67–73, 7 illus.



The new version of the Republic P-47 Thunderbolt. Visibility has been increased because of the new cockpit canopy. Several hundred more horsepower has been added, and increased fuel capacity has extended the range.

United's Pioneer President. Alan Woods. A short biography of W. A. Patterson. Policies and innovations of United Air Lines which have been sponsored by Mr. Patterson are noted. *Airlanes*, May, 1944, pages 16, 39, 61, 2 illus.

Boss of the Heavyweights. Drew Middleton. Biographical data supplement this character study of Lt. Gen. Carl Spaatz, chief of the United States strategic air forces operating in Europe. His career in military aviation is reviewed briefly, from his West Point graduation in 1914 to the role he has played in the present war. Some of his theories on air power are also reported. *Saturday Evening Post*, May 20, 1944, pages 18, 19, 96, 4 illus.

Giuseppe Bellanca. Some highlights in the aviation career of Giuseppe Bellanca are related. The aircraft designer's interest and participation in aviation are traced from 1906. *Airlanes*, May, 1944, pages 28, 53, 1 illus.

Personnel

How Factory Bosses are Humanized. Keith Monroe. A description is given of how the W.M.C. "Training Within Industry" program is improving employee relations with supervisors and foremen at the Ryan Aeronautical plant. Fifteen principles of Ryan personnel policy are listed. It is stated that the company tripled production during 1943 and lost only a third as many people as it hired with these methods. *Wings*, June, 1944, pages 1056, 1057, 2 illus.

Plants

Higgins Aircraft. Col. John H. Jouett. The story of how the Michaud shipyard of Higgins Industries was converted into a government-owned aircraft plant is related, and the plant's physical setup is described. The article is preceded by a brief biography of the writer, who is Vice-President of Higgins Aircraft, Inc. *Airlanes*, May, 1944, pages 22, 23, 43, 2 illus.

Plastics and Plywood

Development of Glass-Reinforced Low-Pressure Plastics for Aircraft. Col. Paul H. Kemmer. **Application of Glass Laminates to Aircraft.** Capt. George B. Rheinfrank, Jr., and Lt. Wayne A. Norman. **Forms, Properties and Handling of Glass Reinforcements.** Games Slayter. **Fabrication of Experimental Low-Pressure Laminates.** H. W. Collins. **Machining Glass-Reinforced Low-Pressure Laminates.** Frank E. Allen. A group of articles gives what is stated to be the first detailed account of the application of low-pressure glass fiber laminates to aircraft.

The first article lists the properties and objectives sought in the development of some nonmetallic materials. It tells about the planning of the development and names the companies that took leading parts in the work. It traces the derivation of the engineering data necessary in the application of plastic materials to structural parts of aircraft and gives in tabular form the properties of various resin materials.

The second article, on the application of glass laminates, gives details of the construction of an airplane fuselage made of laminated glass fiber with a newly developed resin, which was recently built and flight-tested by the Matériel Command at Wright Field. It reviews the experiences of the Matériel Command with high-pressure type laminating resins, telling of the shortcomings of earlier materials and the factors to which particular attention was paid in developing the new glass fiber. Details are given about the work of designing and building the fuselage, the tests to which it was subjected, and comparisons with other aircraft materials.

The third article, about the forms, properties, and handling of glass rein-

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DUCTILITY STRENGTH

forcements, was prepared by members of the staff of the research laboratories of the Owens-Corning Fiberglas Corporation. It gives the results of extensive research work done in connection with the various forms of Fiberglas and lists figures for the modulus of elasticity, tensile strength, dimensional stability, and other properties. The procedure is described at length.

The fourth article, about the fabrication of experimental low-pressure laminates, outlines the techniques employed by the research laboratories of Owens-Corning Fiberglas Corporation in the production of these materials. It describes how the cloth is impregnated and gives information concerning the handling of viscous resins, the curing processes, and schedules. The test procedures described were inspected by representatives of the Matériel Command and the results verified at Wright Field.

The fifth article describes the methods of machining glass-reinforced, low-pressure laminates. It relates the details of the processes of drilling, punching, sawing, grinding, turning, tapping and threading, milling, planing or shaping, and shearing these materials. *Modern Plastics*, May, 1944, pages 89–109, 42 illus.; "Glass Reinforced Plastics for Aircraft," *Industrial Aviation*, June, 1944, page 46, 3 illus.

Economical Tooling for Aircraft Parts. Carrol C. Sachs. A report of studies made of the possibilities of Kirksite as a substitute for steel, as a means toward more economical tooling for limited numbers of plastic aircraft parts. The physical properties and composition of Kirksite are listed. The construction of a mold for the hook antenna mast of a Lockheed Constellation is described. After establishing the suitability of Kirksite in the construction of transfer molds, a further study was made to determine the hobbing characteristics of this zinc alloy. A description is given of experiments conducted to demonstrate that numerous components, such as aircraft doors, cowl and coolant flaps, control surfaces, and floors, can be molded on Kirksite tooling. *Modern Plastics*, May, 1944, pages 124–128, 178, 180, 14 illus.

Plywood and Plastics. W. Nichols. Recent developments in the molding of aircraft plywood are outlined. The writer discusses the Thaden process, developed to simplify bonding operations and to accommodate panels of considerably increased size. Other subjects discussed are the advantages and disadvantages of high-frequency heating and the new Gallay gluing process, which is stated to be outstanding in its simplicity and ease of operation. The chief advantages of this process, which requires no new equipment or plant conversion and no specially trained personnel, are summarized. *Flight*, April 6, 1944, pages 371–374, 6 illus.

A New Bonding Process. Based upon a paper written by Wilfred Gallay and Gerald G. Graham of the Division of Chemistry of the National Research Council of Canada, this article describes the Gallay method for direct-heating of the adhesive lines of laminated wood assemblies. The process is still in the course of active development, but the results that have been achieved in laboratory and full-scale tests conducted at the propeller plant of the S. and S. Aircraft Company, Ltd., are reported.

Essentially, the process consists of rendering the synthetic resin conductive to an electric current by the inclusion of a proportion of acetylene black. In addition to the efficiency of direct-heat application, the Gallay method is said to offer these other advantages: It greatly accelerates the bonding process; heating can be obtained from any ordinary source of electrical supply, can be readily controlled, and is independent of the type of press used for the bonding operation; and special equipment for its application is not required. *Aircraft Production*, May, 1944, pages 210, 211, 2 illus.

Bearing Strength of Plastic Materials. R. T. Schwartz and Edward Dugger, Jr. A report of an investigation undertaken to determine the bearing strength of thermoplastic and filled thermosetting plastic materials at room temperatures. The investigation was made because of the necessity, at times, for using bolted and riveted joints instead of glued or cemented joints, and no data have been available on the bearing properties. Sections of the article describe the materials tested, the test procedure, and the results of the tests. *Modern Plastics*, May, 1944, pages 133–137, 180, 182, 184, 13 illus.

Postwar Aviation

Air Transport and the Future. L. Welch Pogue. An analysis of the probable growth trends in postwar air travel, air cargo, and air mail. Reviewing the history of volume passenger travel, the Chairman of the Civil Aeronautics Board points out that air transport will not depend upon a percentage of existing markets but that its superior speed will create more traffic. It is his opinion that the primary contribution of air transport will be in the development of long-haul traffic and that the extremely short-haul market is at present outside the sphere of air transport's maximum economic utility. With a general decrease in air-transport rates indicated, predictions are made as to the actual rates that will be charged for passengers, cargo, and mail. *Flying*, June, 1944, pages 21–23, 144, 148, 4 illus.

Fundamental Requirements of Post-War Transport Airplanes. Charles Froesch. It is predicted that the change from the wartime mobilization of the air lines to normal commercial practices after the war will take several years. After this there will be a period of readjustment and expansion that will last from 4 to 6 years. Next, there will be the development era of efficient large-scale operation of improved airplanes and ground handling.

It is stated that the transport airplane standardization of the past 7 years with the DC-3 will give way to the development of five distinct types of airplanes in scheduled air transport during the second postwar period. The fundamental requirements and basic specifications for these transport planes are outlined. The principal design criteria and the operating requirements most desirable from the air-line operator's point of view are listed. *SAE Journal*, June, 1944, pages 225, 232 (Transactions), 9 illus.

Postwar Preview. P. G. Johnson. The President of the Boeing Aircraft Company discusses the course of the aircraft-manufacturing industry after the war. It is stated that the activities of the individual manufacturer will depend upon continuing military need for the particular type of airplane he is building today or has ready for production in the immediate future; upon air-line and private-owner needs; upon the adaptability of both his engineering force and manufacturing facilities to

The 5,000th Flying Fortress built by Boeing since Pearl Harbor is autographed with the names of thousands of employees of the Boeing Aircraft Company at Seattle.

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the production of peacetime goods; and possibly upon new markets and the possibility of cooperative efforts with other industries in his geographical area.

It is pointed out that the aviation industry, which has a large responsibility in the prosecution of the war, will have the job of building up peacetime aviation to the point where it can take the fullest possible advantage of wartime growth. *Air Trails*, July, 1944, pages 19, 58, 60, 1 illus.

Belgian Post-War Civil Aviation. By a Belgian Airman. Predicting certain courses that Belgian postwar aviation will follow, the writer explains why he believes Belgium will play a prominent role in future European aerial development. He discusses the continuance and establishment of air lines in Belgium, in the Congo, between Belgium and other European countries, and between Belgium and the Congo. A highly efficient aerial substructure is indicated as a basis for Belgium's postwar air-commerce program, and the hope is expressed that government-subsidized competition will be done away with after the war. It is thought that, within Belgium proper, a single airport of intercontinental size would be sufficient to serve all the traffic, while helicopters are judged to be the most efficient means for transporting people over its comparatively short distances. On the other hand, the distances and nature of the Congo's interior are said to lend themselves particularly to the use of the airplane, not only for air lines but for personal flying as well. *Aeronautics*, May, 1944, pages 28–30, 3 illus.

Selecting an All-Purpose Airline Fleet for Postwar. J. G. Goodenough. While admitting that the question of the types of aircraft that will be required by the commercial air lines after the war is a highly controversial one, the writer suggests four general types as a basis for reasoned argument. Specifications are given for a short-haul passenger or freight transport, an intercity passenger or short-haul transport, a transcontinental or transoceanic transport, and a mail-express transport. Consideration is given to the weight of the engines, fuel consumption, weight of the aircraft, and size. It is stated that whether the use of Diesel engines can be justified on a cost basis will depend on the length of the flight to be undertaken and the charge per pound that can be made on a given flight for freight or for passengers. *Air Transport*, May, 1944, pages 26–29, 4 illus.

A Preface to Postwar Planning. Part IV. George E. Haddaway. The fourth article in this series on postwar aviation planning is concerned with private flying. The record of prewar activity in the personal flying field is reviewed briefly; the effects—both adverse and advantageous—of the war upon civil aviation are noted; and factors that will affect the progress of private flying after the war are discussed. With regard to the postwar market for private planes, the writer

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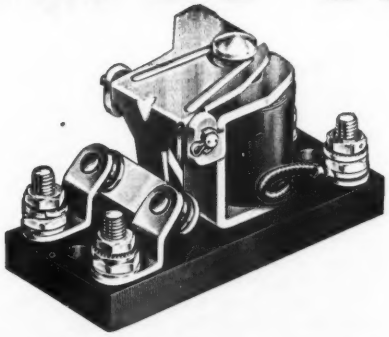

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quotes excerpts from a book titled *A Postwar Outlook for Private Flying*. He also lists certain barriers to future development which are in the process of removal: these pertain to Civil Air Regulations, aviation insurance, and landing facilities. Emphasis is placed upon the importance of building now for the future, through the maintenance of civil aviation throughout the war, through the expansion of aviation education, and through vigilance against restrictive legislation. *Southern Flight*, May, 1944, pages 50, 52, 54.

Post-War Aims in Civil Aviation. Parts I and II. H. Roxbee-Cox. In the first of three articles, the writer lists five objectives for postwar civil aviation. The goals set are: It should provide rapid means of transport between all centers of population on the earth's surface; it should be safe, economical, and comfortable; and it should be an instrument of peace and civilization. He also outlines some of the problems involved in achieving the first of these and indicates probable developments that will take place in the course of further study.

In Part II he goes on to deal with the requirements for safety, economy, and comfort in the postwar airplane. He describes the progress that may be expected in each of these factors. *The Aeroplane*, April 14, 1944, page 409; April 21, 1944, page 441.

Forecast. Andrew Jackson Higgins, Sr. Some comments by the President of Higgins Aircraft, Inc., on the future of air transportation. His more specific observations pertain to the plans of his own company and to the prospects of New Orleans as both an air-transportation and aircraft-manufacturing center. *Airlanes*, May, 1944, pages 7, 64, 1 illus.

Preventing White Elephant Airports. M. W. Cochran. A procedure to be followed in planning for air traffic of the future is outlined. Consideration is given to the study of present air-traffic conditions as a means of evaluating future air traffic. Airports, terminal facilities, and air-traffic control are discussed. Provision is suggested for handling nonscheduled air traffic. The Idlewild Airport, under construction in New York, is used as an example of an airport that will not become a "white elephant." *Air Transport*, May, 1944, pages 40–42, 45, 46, 2 illus.

The Coming Expansion of Airlines in the West. Thomas Wolfe. The future of air transportation in the western part of the United States and the trends it will follow are discussed. Expansion of the air lines in this territory is said to be essential because of several factors: (1) the long distances between comparatively large cities; (2) the rugged nature of the terrain; and (3) limited surface-transportation facilities. Past manifestations of this are demonstrated by the claims that Las Vegas gives the air lines the greatest number of passengers per capita of any city in the United States; that the Los Angeles-San Francisco run has been for some time the most heavily laden air-traffic artery in the country; and that, on a population basis, more air mail has been originating in Los Angeles than in any other large American city.

Differentiating between "feeder" and "secondary" lines, the writer expresses the opinion that air-line expansion in the West will be primarily of the "secondary" type. He outlines primary and secondary routes contemplated by Western Airlines and analyzes the factors that will determine the secondary points. Of these, he dwells mainly on the type of equipment that will be used and the airport facilities and services that will be necessary. In addition to listing the elements that are required for the establishment of an air line, the writer also comments on the possible need for subsidies for the secondary air-line routes, the need for uniformity in state legislation on air transportation, and the potentialities of the helicopter for air-line use. *Western Flying*, May, 1944, pages 41, 90, 92, 1 illus.

A Blueprint in the Skies. Capt. Eddie Rickenbacker. The President and General Manager of the company reveals some of the postwar schedules that Eastern Air Lines is contemplating for air travel between North and South America. Proposed extensions of routes and services are outlined. *Airlanes*, May, 1944, pages 11, 52, 62, 1 illus.

Private Flying

Here Lies Private Flying. Devon Francis. Contrary to optimistic opinions about the great numbers of personal planes that will be flying the airways after the war, the writer argues that the use of private airplanes will be limited and will not begin to rival that of the automobile. Although his reasons include the need for better aircraft and for landing and navigational installations, his conclusions are based primarily upon the claim that excessive government control hampers the development of private flying. *Skyways*, June, 1944, pages 44–47, 92, 3 illus.

Production

A Message from England. Edward C. Bowyer. The Joint Chief Executive and Chief of Information Department, Society of British Aircraft Constructors, discusses some of the fundamental features of British aircraft production. Indicating the conditions that necessitate decentralized production, he explains the "group" system of manufacture. A typical example of how the group system operates is offered by a description of the methods devised for producing the Halifax.

The fact that British aircraft production embodies no modification centers as such, but provides broadly for design changes on the production line, is noted and attention is called to the extensive standardization of components, as well as to the flexibility of manufacture. In addition to crediting the private manufacturer with much of the progress achieved in British aircraft development, the writer praises the cooperation and foresight of the Air Staff. He gives a number of specific developments in which British engineers have played a leading part. These include: power-driven gun turrets, radiolocation, jet propulsion, the sleeve-valve aircraft engine, and the two-stage mechanical supercharger. *Aero Digest*, May 15, 1944, pages 51–53, 231, 6 illus.

Statistical Methods of Quality Control. Craig Stirewalt and Jean Bordeaux. To interpret the principles of the statistical method of controlling the quality of parts during manufacture, examples of size variations occurring in simple screw-machine products are charted. The writers concentrate on the interpretation of data plotted graphically. Inspection methods are classified and explained and examples are given. Mathematical processes for establishing control limits are outlined. Curves made from tabulated data and record forms are reproduced. *The Iron Age*, May 11, 1944, pages 56–60, 5 illus.

Electronic Heating Applications in Aircraft. J. P. Jordan. An article discussing the induction heating of metals and the dielectric heating of nonmetallic materials. The history of these processes is outlined. Several major applications in the induction-heating field are described. In conclusion, it is stated that there are a multitude of induction- and dielectric-heating applications for aircraft that have not yet been fully investigated and that when the war ends investigations of the new fields should proceed rapidly. *Industrial Aviation*, June, 1944, pages 26, 28, 64, 2 illus.

Tooling Is Foundation of Aircraft Construction. A. J. Giebel. A brief outline is given of the functions and activities of the tooling department of an aircraft-manufacturing plant. To illustrate tooling procedure, the designing of a jig or fixture is described. *The Draftsman*, May, 1944, page 18.

Duplicated Loft Layouts in Metal Prove Better Than Templates. Louis S. Fell and Philip P. Eppons. It is explained that a new reproduction system developed by Curtiss-Wright has made it possible for the company to provide subcontractors with duplicate metal loft layouts of the assemblies that they are to make. These are used instead of the working templates of the parts themselves. Among the advantages gained with the new system is the fact that subcontractors can now work out their own templates and adapt jobs to available machines. *Wings*, June, 1944, pages 1049–1053, 13 illus.

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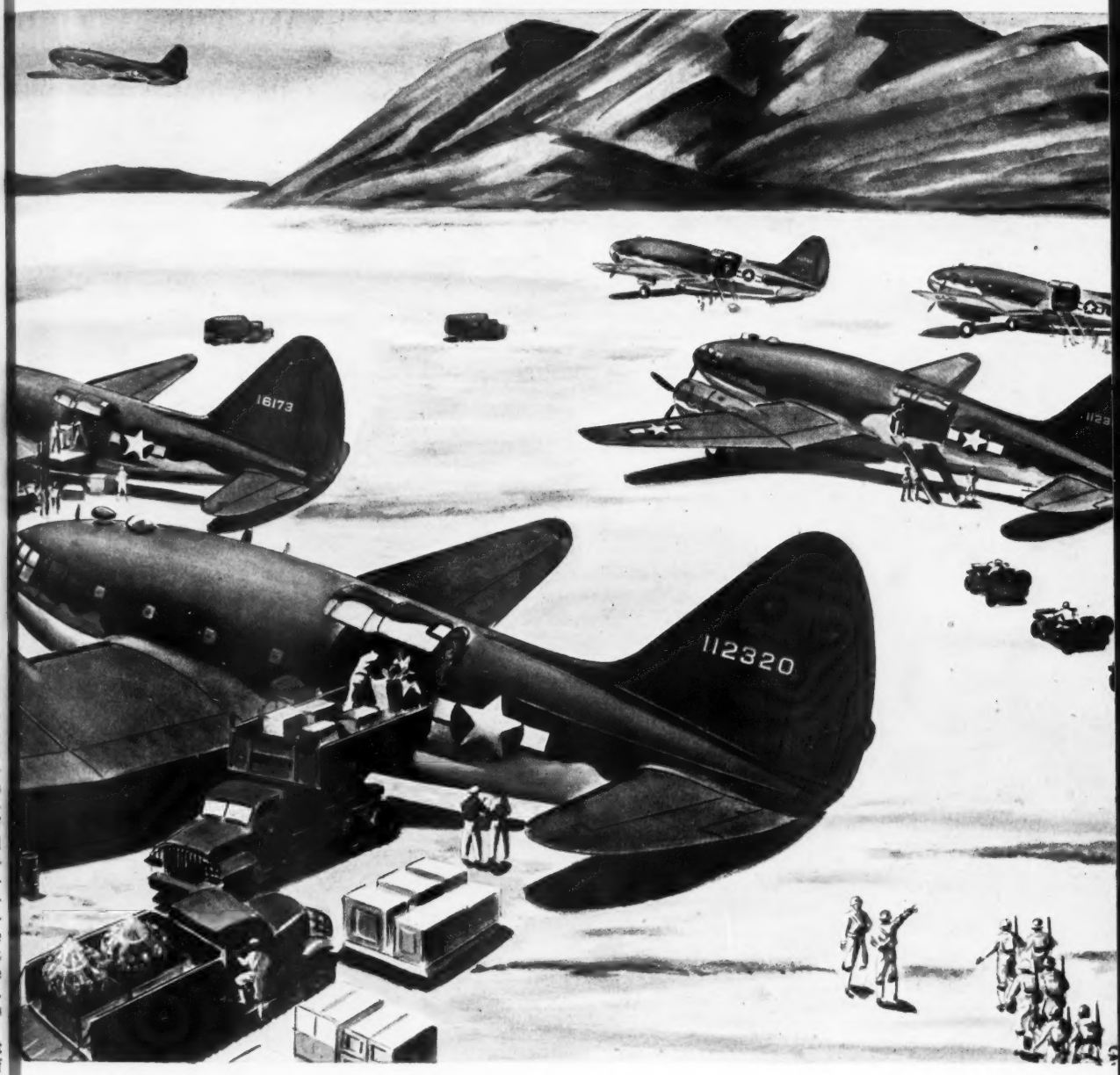

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Meanwhile work is continuing on two other war projects, America's first jet propelled plane, and the new Bell Helicopter.

Post-war activities are being locked in our minds until the day of Victory. Then our organization, staffed with production men of skill and imagination, will turn their thoughts to pioneering in an aviation world at peace.

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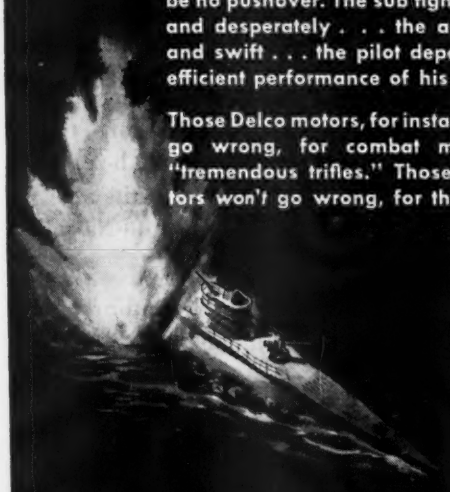

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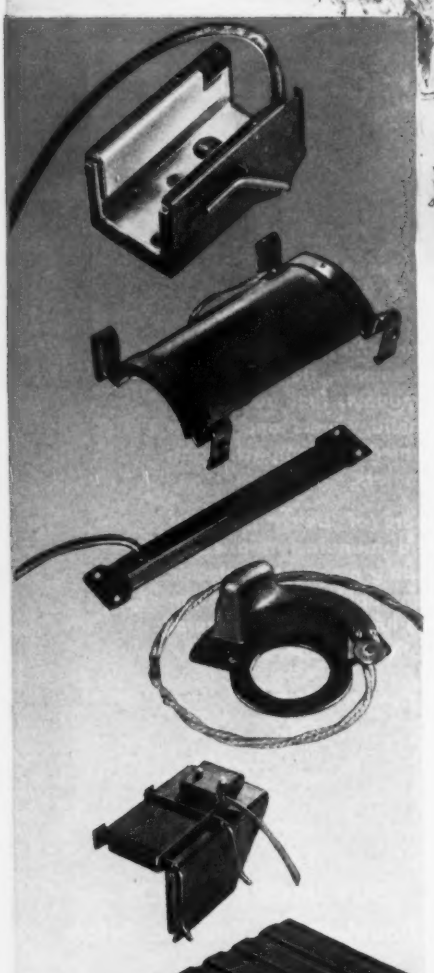

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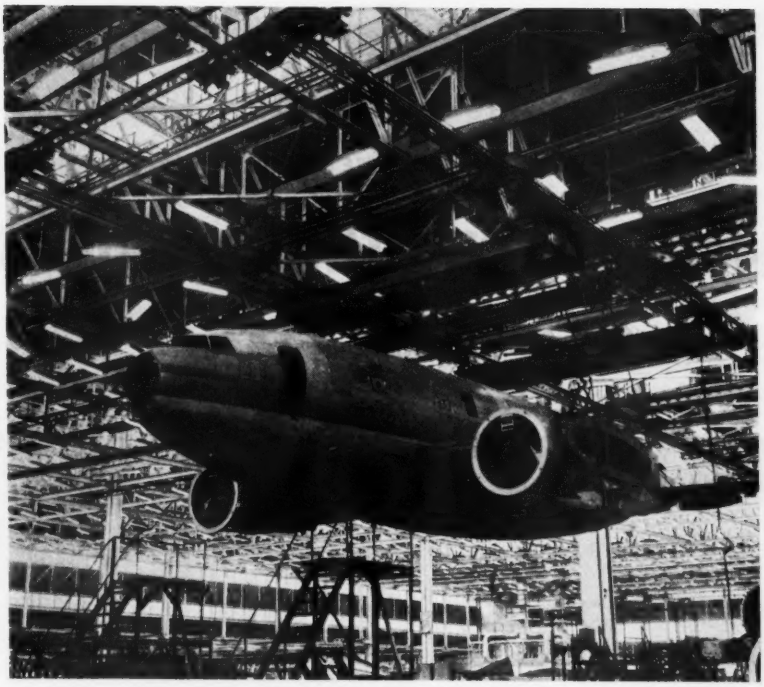
Annealing Aircraft Parts in Pan American Shops. F. K. Whiteside. A description is given of Pan American's new repair shop where radiant heat is used to anneal and harden aluminum-alloy parts. Furnace design and operating methods are discussed. *The Iron Age*, May 25, 1944, pages 60, 61, 132, 2 illus.

Safety on the Assembly Line. A. D. Caddell. A survey of some of the precautions that can be taken in the control of aircraft-plant layout, machinery, and production and flight-testing processes for the purpose of safeguarding personnel against undue exposure to danger. The safety problems considered are chiefly those relating to the final-assembly line. They include hazards arising from the various elevations at which the final assembly operations must be performed; moving materials onto the assembly line; the employment of high-frequency electric extension tools; and the use of hydraulic controls, folding or trailing wing sections, bomb bay doors, etc. Other safety problems discussed are: eye protection on the assembly line, hair arrangements and clothing of women workers, whirling propellers, taxiing aircraft, and the use of high-octane fuel. *Aero Digest*, May 15, 1944, pages 60, 61, 227, 229, 4 illus.

Bending Time of Aircraft Spar Caps Reduced by Induction Heating. E. H. Plesset and J. R. Chadwick. A report of an investigation of the possibility of heating spar cap billets quickly by induction methods. It is stated that the investigation, which was conducted by Douglas Aircraft Company, revealed the complete feasibility of this method for achieving a uniform temperature of 350 to 400°F., within a few minutes, in the region to be bent, in contrast to the gas furnace method, which required 2 hours. A schematic diagram of the basic method is shown. Sections of the article discuss the equipment, tests, and results obtained. *Automotive and Aviation Industries*, May 15, 1944, pages 20, 21, 86, 6 illus.

Steel Castings in Aircraft. J. F. B. Jackson. Opinions are offered on the applications, advantages, and properties of high-tensile, alloy-steel castings for aircraft production. Some of the fundamental principles of casting design are outlined and special foundry techniques for developing required characteristics are discussed. Noting the extensive use of steel castings by the Germans, the writer analyzes the conditions to which they have adhered in their applications. He shows by this analysis that the employment of high-tensile, alloy-steel castings for aircraft manufacture can result in weight and time economies, reductions in production cost, and improved mechanical design. *Aircraft Production*, May, 1944, pages 207–209, 5 illus.

Ammunition Chute and Booster Tooling Problem. Friend F. Baker. This article tells how tool and aircraft engineers pooled their knowledge in order to solve problems connected with the quantity production of ammunition chutes and boosters. The development of a flexible feed chute for 0.50-caliber ammunition is described. No production machinery existed for the job, but after much planning, designing, and experimental work a practical chute was produced. The development of the Hughes booster for 0.50-caliber ammunition is also described in some detail. *Industrial Aviation*, June, 1944, pages 42–45, 67, 7 illus.



A completed C-46 fuselage is lifted from a secondary fixture where the nose and tail sections and the two nacelles were added. The fuselage is being taken to the production line cradle.

Hawker Typhoon. Part II. Wilfred E. Goff. A continuation of an article detailing the production processes employed by the Gloster Aircraft Company, Ltd., in the manufacture of the Hawker Typhoon. Part II reviews the methods used in the building of the fuselage, including the construction of the girder and monocoque portions of the fuselage, as well as the frame. Particulars are given on the quarter-section assembly, assembly fixture, hood rails and transport joint, tail section, tail-section assembly, fin assembly, and fin-to-tail section. *Aircraft Production*, May, 1944, pages 212–225, 41 illus.

Contour Forming of Extrusions. Jack Johnson. A description of the stretch-forming of airplane parts to contour—a method that is stated to simplify greatly the making of parts difficult to form by other methods since it entails relatively little tooling cost. The forming of extrusions and sheet metal sections is discussed in considerable detail. *Automotive and Aviation Industries*, May 15, 1944, pages 22–25, 214, 21 illus.

Hand Drilling Operations Speeded Up. Robert A. Trumpis and H. Honsberger. A description of a drilling system for fuselage manufacture using a self-centered drill attachment and 60° countersunk guide holes in a panel jig, which is stated to have reduced drill breakage, cut the time for hand-drilling operations, and improved the quality of work. A tabulation gives the comparative time and other factors involved in five methods of drilling, with the featured method shown as requiring 1.40 sec. per hole drilled compared with 5.23 sec. for the slowest method tabulated. Each method is explained and eight advantages of the selected method are outlined. *The Iron Age*, May 18, 1944, pages 72, 73, 2 illus.

Analysis of Progress Trends in Aircraft Production. C. J. Rigdon. The application of progress analyses to the work of planning production schedules is discussed. A formula is described for computing the reduction of man-hours per plane in proportion to the increase in number of planes produced. After observing that actual production figures seldom agree exactly with estimates based on mathematical calculations, the writer analyzes the deviations with a view toward discovering and correcting the irregularities. He suggests formulas, charts, and special slide rules designed to make possible an easy analysis of current production trends.

A method is outlined for computing and charting the five values upon which the system is based. These are listed as two values representing airplane-sequence number; two values, cumulative hours per airplane; and one, the per cent of the curve. It is stated that any one of the five values can be computed from the other four known or estimated values. Examples are given

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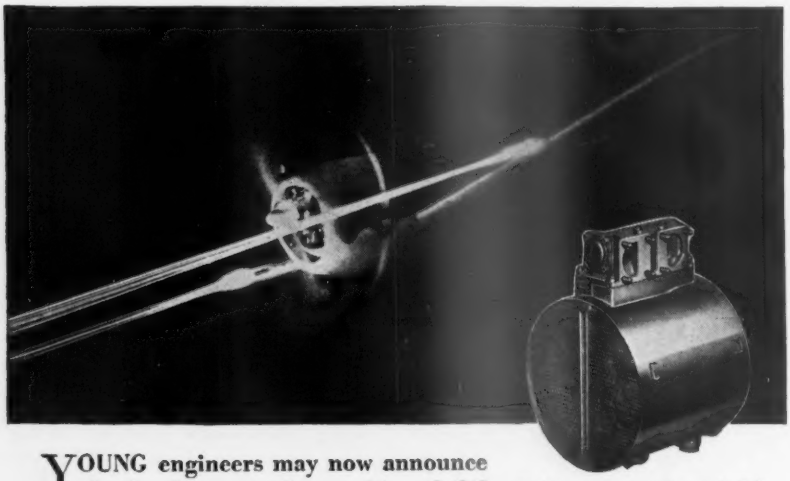

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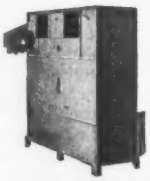

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to show the application of the method. A special slide rule for dealing with man-power forecasts where the total cumulative hours are used instead of the cumulative average hours is described and its use is demonstrated by examples of actual shop practice. *Aero Digest*, May 15, 1944, pages 132, 134, 137, 233, 235, 8 illus.

Power Gets a Boost. Esther H. Forbes. Following a tour of the Kansas City plant of Pratt & Whitney, the writer describes how production of the new 2,100-hp. R-2800-C Double Wasp engine is being carried out. It is explained that when ground was broken for the plant it was intended for the production of the R-2800-B engine. Development was well along when it was decided to tool the plant for the production of the more powerful engine. An outline is given of the layout and equipment of the plant. *U. S. Air Services*, May, 1944, pages 23, 26, 1 illus.

Hydraulic Stretch-Forming of Aircraft Parts. Richard Seifried. A description is given of a machine manufactured by the Hufford Machine Works, which is stated to be helping to solve forming problems in aircraft manufacture connected with the contouring and degreeing of extrusions, rolled stock, and narrow sheet stock to angles and shapes required in wing and fuselage construction. The operating principle of the machine is explained and an outline is given of its construction. Contouring and degreeing are uniformly accomplished in a single operation. The operating cycle is automatic once the machine is started. *Industrial Aviation*, June, 1944, pages 48, 49, 66, 5 illus.

Drilling Navy Fighter Plane Engine Mounts. William J. Hoffman. A brief description is given of an arrangement for performing drilling operations that solved problems connected with the building of the engine mount for the Grumman Navy fighter. The welded engine mount is placed on a machine built especially for drilling, tapping, and spot-facing the attachment lugs. The machine is equipped with a Leland-Gifford back-geared, eight-speed drill head, with locking blocks and plates for positioning the mount, so that two sets of three holes each can be drilled and tapped in the mount. Other operations of counterboring, spot-facing, reaming, and tapping are facilitated, and relationships between the attaching bolts and bosses are held within close limits by this method. *Machinery*, May, 1944, pages 170, 171, 3 illus.

Curtiss-Wright Facilities for the Fabrication of Large Sections. Joseph Geschelin. Additional information is given concerning the facilities used and the procedures followed in the production and assembly of Curtiss airplanes. Details are given on the operations involved in fabricating and assembling the components of the C-46 air frame by means of subassemblies and the use of special fixtures. Similar information is also given concerning

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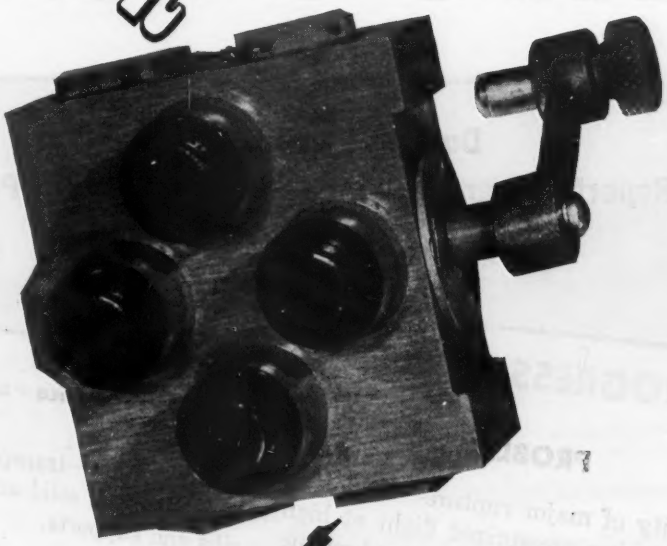

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PROGRESS REPORT

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ADVANTAGES

Self-sealing tendencies — penetration is confined to the area of the actual point of impact, and the interlayer of "Butacite" tends to seal the hole or confine it to small size even under pressure. Hole easily and quickly patched in flight with prepared disc of "Butacite."

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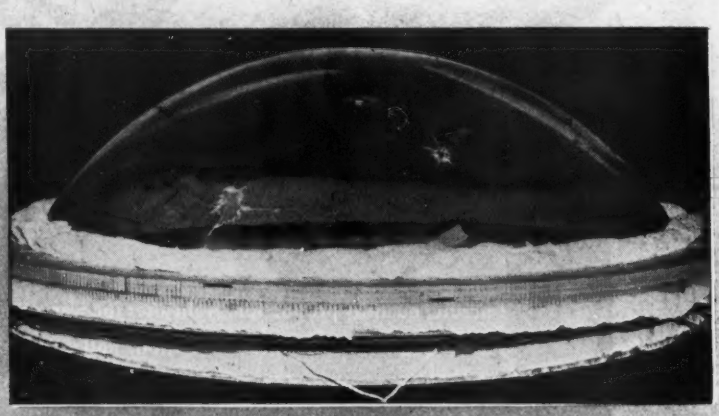
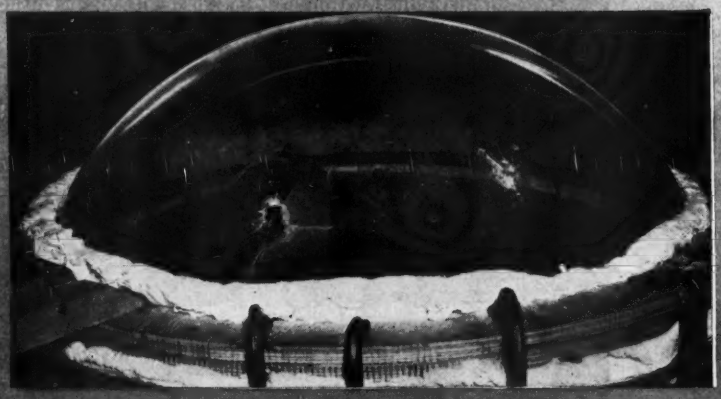


Pressurized laminated "Lucite"-"Butacite" enclosure punctured by a bullet from a 50-caliber gun. Inside air temperature of enclosure +50°F, outside air temperature −41°F, internal pressure 5 psi. Size of hole is small enough to retard rate of pressure loss and permit immediate sealing of the hole.



This is another view of the same laminated dome—after being patched, rotated to a new line of fire, and punctured with another bullet from a 50-caliber gun under exact conditions as described above. Note that the patched area remains intact, in spite of pressurization and the shock of a second bullet.

Development work and unlaminated sheet stock by: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J. Address inquiries to Du Pont in Arlington, or in Canada, to Canadian Industries, Ltd., Box 10, Montreal.

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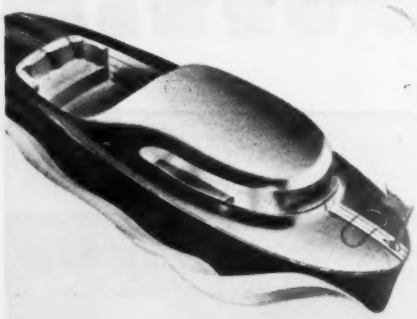

I predict quantity production, right after the war, of unsinkable boats with continuous skins, tougher and lighter than wood, hull and top sides molded in one piece of Co-Ro-Lite, a new molding material consisting of plastic bonded rope fibres. Scale models of such boats are now being tested under a variety of conditions, and hulls of similar construction up to 32' have already been successfully molded. Light weight, speed and low cost will be overall outstanding features. The skin-stressed monocoque construction produces a light weight hull and top. An aluminum aircraft-type engine, housed out of the way in a small space under the aft deck, will provide speed and low operating expenses. Production by molding assures low initial cost, and a one-piece hull, eliminating yearly overhaul and caulking, means low upkeep. Thus motor-boating will be a pleasure everyone can buy with their War Bonds when Peace is restored.

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final assembly of the P-40 fuselage, with the successive operations outlined. *Automotive and Aviation Industries*, May 15, 1944, pages 34–36, 38, 40, 13, illus.

Machining Magnesium Alloys. L. B. Whitburn. Reference is made to conditions in Great Britain following the outbreak of the present war when the demand for magnesium aircraft parts became great. It is stated that many machinists who had scarcely heard of magnesium were required to machine castings of this material. Bad machining with resultant rejections and waste occurred. The writer outlines proper methods of machining light alloys. *Light Metals*, May, 1944, page 217.

Propellers

From Billet to Blade. The processes of fabricating forged aluminum blades for Hamilton Standard propellers are traced from raw material to finished product. Techniques and equipment described embody two distinct production phases, each carried out by a different organization. It is related in detail how the forging plant of the Chevrolet Division of General Motors shapes aluminum ingots into billets; then, how the rough blades are machined, polished, painted, and balanced ready for assembly by the Frigidaire Division. The use of an overhead conveyer system by the latter unit for the moving of all material is particularly noted. *Aviation*, May, 1944, pages 145–150, 17 illus.

Radio

Approach to the Problem of Radio Precipitation Static. Part II. C. J. Breitwieser. Conclusion of a two-part article on the causes and cures of precipitation static in aircraft radio. Having explained in the first installment the causes of the phenomena, in this installment the writer discusses methods of reducing radio interference of this nature. He groups the procedures into two general classifications: (1) treatment of the airplane and (2) treatment of the radio apparatus. Under treatment of the airplane, examination of ways in which the surface and exterior of the plane may be treated so as to minimize the rate of electric-charge accumulation is followed by descriptions of the devices that are used to minimize the effects of the charge, once it has accumulated. Approaching the problem through the design and treatment of the radio apparatus, the following means of combating precipitation static are studied: frequency-modulation systems, noise-reduction antennas, loop antennas, and noise-limiter circuits.

In conclusion, the writer predicts that the intensified investigation now being made of precipitation static probably will result in the development of: (1) a method of treating the airplane which will reduce the accumulation of electric charge; (2) a device for the continuous discharge or draining off of the accumulated charge in such a manner as to minimize or eliminate radio interference from this source; (3) a superior noise-reduction antenna, possibly of the shielded-loop variety; and (4) a radio receiver that is considerably less sensitive to all types of noise. *Aviation*, May, 1944, pages 151–153, 267, 5 illus.

Lockheed's New Radio Testing Station. The operational testing station, installed by Lockheed Aircraft Corporation on a summit in the Santa Monica Mountains, is described. Although the station's immediate purpose is the testing of every radio in each Lockheed plane, its 14 receiving sets and seven transmitters enable it to operate throughout the entire range of radio frequencies, including some that are at present largely theoretical or experimental. Emergency generators ensure the continuation of operations even in case of total power failure from sabotage or bombardment. *Aero Digest*, May 1, 1944, page 106, 1 illus.

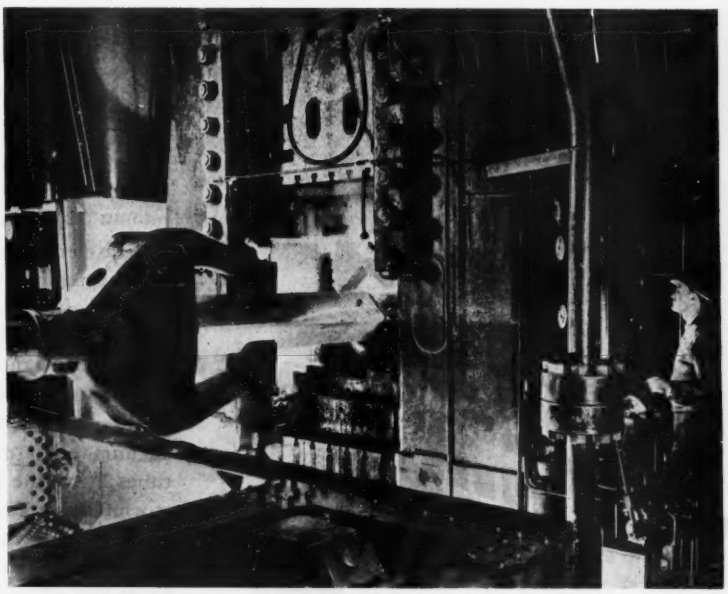
United Air Lines' Radio Research Program. D. F. Hambrick. United Air Lines' research and experimental activities in the field of aircraft radio are reviewed. Accounts are given of the air-line company's work in connection with the development of the static discharger, the absolute altimeter, and various devices for testing radio equipment. Instrument landings and ultra-high-frequency radio are also discussed. The radio installations used in the Douglas DC-3 transports from 1937 to 1940, the radio systems used on United Air Lines' current Mainliners, and the company's facilities for testing and developing new radio equipment are described. Notes are also included on United's teletype circuits. *Flying*, June, 1944, pages AC-5, AC-6, AC-8, AC-9, AC-23, 7 illus.

Plywood Masts Expedite Field Radio Installation. Details are given about the portable radio masts that are employed for ground-to-plane communication at A.A.F. advanced airfields. Supplied in two heights, either 50 or 75 ft., the masts are used for both transmission and reception. They are composed of sections of tubular hardwood plywood, joined by sleeve couplings and fastened by metal collars and eyebolts. It is reported that a crew of three men can erect a mast and have the radio in operation within 30 min., while disassembly is stated to be even faster. *Aero Digest*, May 15, 1944, pages 118, 220, 4 illus.

Reaction Propulsion

Gas Turbines: Present Status and Future Prospects. S. A. Tucker. The present status and future prospects of the gas turbine for various applications, including aircraft propulsion, are discussed.

In discussing the relationship between gas turbines and jet propulsion for aircraft, the writer notes that jet propulsion requires either (1) carrying both fuel and oxygen in condensed form aboard the plane, or (2) carrying a compressor on the plane to produce an available pressure differential. The former partakes of the character of a rocket and is applicable to producing a large impulse for a short time. The latter offers a means of producing a



An aluminum billet undergoes processing preparatory to being forged into a propeller blade at a plant of the Chevrolet Motor Division, General Motors Corporation. This close-up of the 3,000-ton hydraulic press shows the claw of the manipulator inserting an aluminum billet 12 in. square by 9 ft. long into the "vee" die. The operator at the right controls the press, which squeezes the billet into an ingot 9 in. square. This great pressure causes a realignment of molecules, increasing tensile strength of the metal from about 40,000 lbs. per sq.in. to approximately 55,000 lbs. per sq.in.

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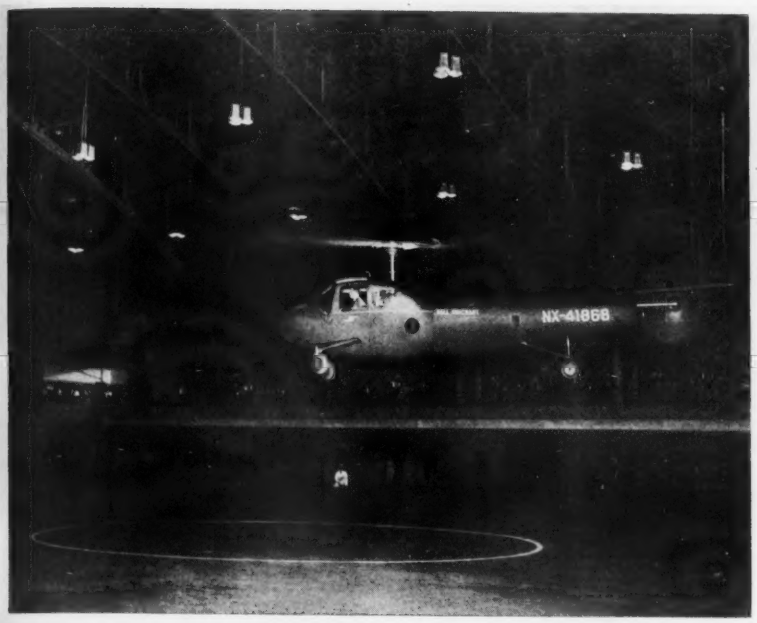

The Bell helicopter in flight inside the 65th Regiment Armory in Buffalo, N.Y., on the night of May 10, 1944. Floyd W. Carlson, experimental test pilot, was at the controls during an exhibition for Civil Air Patrol Authorities. This is believed to be the first such flight in this country and the second in the world.

continuous jet of any desired size and for as long a period as the fuel supply lasts.

It is stated that if some form of air compressor is to be carried in flight, the axial-flow type (or some modification) offers the least weight and highest efficiency. For this compressor, a gas turbine of high speed and few stages is definitely superior to any other known drive. Jet propulsion represents a specific case of taking the entire output of a gas-turbine unit as the momentum of a jet of hot gas.

Plane designers choose jet propulsion in preference to the conventional propeller (1) to obtain higher speed; (2) to secure greater horsepower per engine than is available from internal-combustion types; (3) to secure greater horsepower per engine than can be handled by individual propellers; or (4) to utilize low-grade fuel not suitable for present aircraft engines. Unquestionably, the type of pursuit aircraft now being jet-propelled has developed from the first of these but has also acquired the fourth as a by-product.

For future air transport, the advantage of greater horsepower per engine may be the primary desire, with the other features developing as by-products. Gas turbines of the type that might drive future aircraft can be designed so that practically all the power output can be taken by a shaft and gears to a propeller, with the jet as an auxiliary, or so that practically all the power is delivered to the jet, yet with some degree of flexibility under control of the pilot as to which supplies the main driving force. *Mechanical Engineering*, June, 1944, pages 363–368, 7 illus.

Spear Shaped Weather Rocket. Constantin P. Lent. A brief description is furnished of a rocket of novel construction intended for weather research, the primary function of which is to carry recording instruments to high altitudes for long-range weather forecasting. *Astronautics*, March, 1944, pages 11–13, 5 illus.

Turbine-Compressor Units. G. Geoffrey Smith. In this article on turbine-compressor units it is stated that where high powers—for example, 5,000 hp.—are under contemplation, it would appear that simple centrifugal or rotary displacement-type components must give place to axial-flow or multi-stage designs. It is noted that the production of a large gas turbine-compressor unit involves fewer problems than the building of a small unit of 400 to 500 hp. The single-wheel turbine, however, can be employed with success. Problems connected with building these are outlined. Component efficiencies are discussed. Reference is made to Whittle's successful development of a relatively small gas turbine. It is stressed that this new engineering development should not be considered solely as a jet-propulsion unit, but that jet propulsion should be considered as a special application of the gas turbine. Fuel consumption factors are discussed and the benefit gained from heat exchangers is considered. *Flight*, April 6, 1944, pages 360, 361, 3 illus.

Does Germany Have Jet Propulsion? James L. H. Peck. An analysis of reports and technical developments indicating the progress of jet propulsion in Germany. The writer discusses the need for jet-propelled aircraft in Germany, the extent to which Germany may be producing jet-propelled planes, German experimental work in this field, and the possible future increase in the production of jet-propelled planes in Germany. *Air Trails*, July, 1944, pages 26, 27, 66, 1 illus.

Electronic Spacial Rocket. Robert L. Sternberg. It is suggested that there are long-range possibilities of developing a craft for traveling beyond the atmosphere through the utilization of a stream of electrical-charge particles accelerated by electrostatic fields and guided by magnetic fields. Rocket engines of this type would be similar in principle to a cathode-ray oscilloscope on a greatly magnified scale. The writer describes how such a device might be built and employed for propelling a craft for interplanetary flight. *Astronautics*, March, 1944, pages 15, 16.

Rotating Wing Aircraft

The Helicopter Promise. Enea Bossi. Features of the helicopter being developed by Higgins Aircraft, Inc., are described. Attention is called to the principle that enables the fuselage to remain horizontal at all times. With a diameter of 32 ft., the four-bladed rotor is reported to turn at a speed of over 325 r.p.m. A horizontal seven-cylinder engine developing 170 hp. powers the helicopter. The cockpit is located in the front of the fuselage and side-by-side seating is provided for pilot and one passenger. Although the first model of the Higgins helicopter was constructed of wood, it is stated that future construction will consist mainly of plastics. *Airlines*, May, 1944, pages 27, 46, 48, 2 illus.

Stress Analysis

The Intrinsic Theory of Thin Shells and Plates. Part I—General Theory. Part II—Application to Thin Plates. Wei-Zang Chien. The purpose of this paper is to give a systematic treatment of the general problem of the thin shell, which includes the problem of the thin plate as a special case. The work is based on the usual equations of elasticity for a finite body, supposed to be homogeneous and isotropic. The final equations of Part I are the three equations of equilibrium and the three equations of compatibility for the six unknowns, which represent extension and change of curvature of the middle surface. When these quantities are found, the strain and stress throughout the shell or plate can be calculated. The displacement does not appear explicitly in the argument. Since stress, strain, and curvature (all tensors) are dealt with, the tensor notation proves much more convenient than any other.

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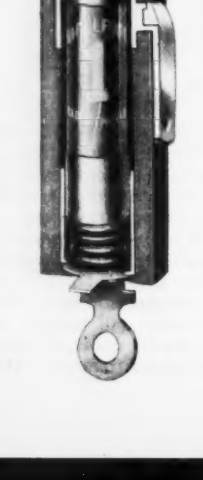

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In Part II the various approximate forms of the equations arising from consideration of the thinness of the shell or plate and the smallness (or vanishing) of its curvature are discussed. A systematic method of approximation based on the thinness of the plate is developed. It is found that thin-plate problems may be classified into twelve types, according to the relative orders of magnitude. Among these twelve types are the problems of finite deflection, of small deflection, of extremely small deflection, and of zero deflection. In each case, the problem reduces to the solution of a set of partial differential equations that varies for each type. These differential equations are given in one table. The principal parts of the macroscopic tensors and the orders of magnitude of the external forces for each case are given in another table. *Quarterly of Applied Mathematics*, January, 1944, pages 297–327, 2 illus.; April, 1944, pages 43–59, 1 illus.

The Strength of Glued Joints. N. A. de Bruyne. This article describes research conducted by Aero Research Ltd. to find a simple relation between the strength of a lap joint and its geometry. The relation is found in the "joint factor," which is defined as the square root of the thickness of the sheet divided by the length of the overlap. The strength of different types of glued metal joints is discussed.

An alignment chart for finding the joint factor and breaking stress of Redux joints in steel and Duralumin is shown and its use is described. Test results are tabulated. The relative strength of joints made by the Redux process and those made by riveting and spot welding is compared. *Aircraft Engineering*, April, 1944, pages 115–118, 10 illus.

An Application of Orthogonal Moments to Problems in Statically Indeterminate Structures. W. M. Kincaid and V. Morkovin. This paper is an attempt to reduce the work involved in the solution of equations for determining moment profiles in statically indeterminate structures.

The approximate methods are usually simple to apply, but when employing them it is necessary to specify numerical values for the dimensions and stiffnesses (or their ratios) of the structure involved. The exact methods consist of solving systems of linear equations obtained by setting up relations between generalized displacements or by the equivalent means of using Castigliano's Principle. As the degree of indeterminacy of the structure increases, the solution of the equations becomes more laborious. Most of the methods aim at reducing such labor by a suitable choice of unknowns.

A problem is assigned and its solution worked out to demonstrate the method suggested. An example is given to illustrate an efficient arrangement of the work. A table giving data used in the solutions is reproduced. *Quarterly of Applied Mathematics*, January, 1944, pages 334–340, 7 illus.

A Strain Energy Derivation of the Torsional-Flexural Buckling Loads of Straight Columns of Thin-Walled Open Sections. N. J. Hoff. In the thin-walled open-section columns of modern aluminum-alloy aircraft, torsional buckling and combinations of torsional and flexural buckling are of considerable importance. The critical loads corresponding to these types of instability have been calculated by integrating the differential equations of the problem. In the present paper the torsional-flexural buckling loads are determined with the aid of the Rayleigh-Ritz-Timoshenko method. This procedure obviates the derivation and integration of the differential equations, as well as the geometric considerations connected with what Goodier termed "Wagner's hypothesis."

The equilibrium of a straight bar of a given length and cross-sectional area, loaded axially with a compressive force distributed uniformly over the end section, is investigated by assuming that each section of the bar undergoes a virtual displacement. *Quarterly of Applied Mathematics*, January, 1944, pages 341–345, 1 illus.

Use of Sine Transform for Non-Simply Supported Beams. A. G. Strandhagen. It is noted that the problem of nonsimply supported beams can be approached by various mathematical procedures. Certain applications of the common methods involve long and tedious calculations. It is shown that by employing the sine transform the work can be made easier in most cases. Definitions and mathematical solutions are given to demonstrate the improved method advocated by the writer. *Quarterly of Applied Mathematics*, January, 1944, pages 346–348, 1 illus.

The Treatment of Discontinuities in Beam Deflection Problems. C. L. Brown. A less cumbersome method is offered for the evaluation of constants of integration. This refers to methods of determining the deflections of beams, all of which arise from a fundamental differential equation. The suggested method deals with the right-hand side of the fundamental equation mentioned, which is stated to be sectionally analytical. The two constants of integration appearing in each section are simplified in the suggested solution. *Quarterly of Applied Mathematics*, January, 1944, pages 349–351, 2 illus.

The Distortion of the Boussinesq Field Due to a Circular Hole. A. Barjansky. One of the most important problems in the theory of elasticity is the solution of the biharmonic equation for a given group of boundary conditions. The most common approach to the solution of this problem consists in selecting a system of coordinates particularly suited to the region studied.

The present paper is an attempt to apply Jeffrey's approach to the problem of the distortion introduced in the so-called plane Boussinesq field by the presence of a circular hole. Starting with the stress function of the undistorted Boussinesq field, an auxiliary stress function is found that satisfies the differential equation and all the boundary conditions. The stresses and strains in the discontinuous field are then directly determined. *Quarterly of Applied Mathematics*, April, 1944, pages 16–30, 5 illus.

Effect of a Small Hole on the Stresses in a Uniformly Loaded Plate. Martin Greenspan. The National Bureau of Standards has recently made tests on steel columns having perforated cover plates. Most of the perforations were of so-called ovaloid shape—i.e., a square with a semicircle erected on each of two opposite sides. The tests on the columns included experimental determinations of the distribution of stress in the neighborhood of a perforation and the results obtained aroused interest in the development of a theory for the distribution of stress in a large, uniformly loaded plate having a single ovaloid hole. In this paper an exact solution to the problem is obtained for a hole having any boundary of which the equation can be expressed in the parametric form. *Quarterly of Applied Mathematics*, April, 1944, pages 60–71, 9 illus.

Testing

Electrical Strain Gauging. C. G. A. Woodford. A study of the technique for using resistance strain gauges for measuring the stresses in complex bodies or structures under mechanical loads. The general principle of strain gauges is outlined and their development briefly reviewed. Fundamental aspects of the strain-gauging process, such as methods of winding, the types of alloys that are needed for the wire material, strain sensitivity, temperature effects, and circuit arrangements, are explained. Details are also given on static testing, shear and torsion, dynamic testing, recording apparatus, amplifiers, photo recorders, and composite tests. Differences in British and American practices are noted and, in indicating specific aircraft applications for the technique, equipment used by Rotol Ltd., Douglas Aircraft Company, and The Glenn L. Martin Company are mentioned. *Aircraft Production*, May, 1944, pages 245–249, 9 illus.

Radiation Pyrometry in Turbosupercharger Testing. V. P. Head. It is indicated that, because of the increase in the operating temperatures and speeds of turbines such as are used in turbosuperchargers, the demands for turbine-wheel and bucket temperature measurement have become increasingly exacting. It is stated that requests appear for such measurements under operating conditions with measurement tolerances varying from ±50°F. in flight test to ±5°F. in certain ground tests. This paper describes the procedures used for measurements ranging from as low as 300°F. up, the methods used being optical pyrometry, fusible alloys, fusible compounds, and contact thermocouples. General applications and the theory of thermoelectric radia-

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tion pyrometry are discussed and tests of commercial and experimental pyrometers are described. *Transactions of the A.S.M.E.*, May, 1944, pages 265-269, 9 illus.

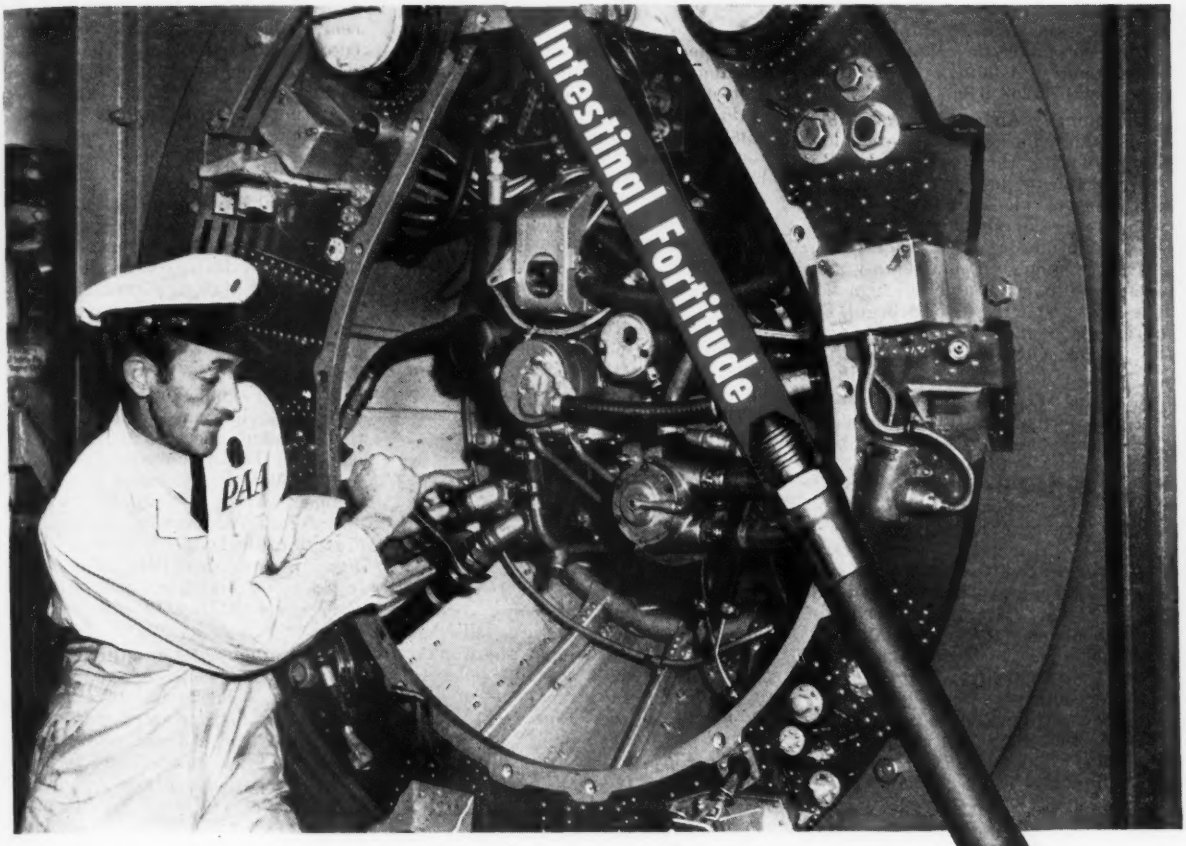
Testing Equipment

Adjustable Frequency for Model Plane Testing. C. C. Clymer. This article deals with the extremely powerful small-sized motors that have been designed to represent the engines in model airplanes used for wind-tunnel tests. To meet the requirements for high and adjustable frequency, these units make use of frequency converters through which a considerable part of the power is passed from the a.c. line without being converted or inverted. Two of the units have the following specifications: (1) 1,060 kva., 440 volt, 110 cycle, with range down to 145 kva., 60 volt, 15 cycle; (2) 117.5 kva., 505 volt, 400 cycle, with range down to 29 kva., 126 volt, 100 cycle. They are primarily wound-rotor induction motors that, at a standstill, deliver 60 cycles through the transformer action of the windings. If driven against their normal rotation, the frequency is increased to 120 cycles at normal speed and 180 cycles at double speed. A few typical ratings of the model-plane motors are listed. *Aero Digest*, May 15, 1944, pages 114, 220, 2 illus.

High-Speed Multiple-Point Potentiometer Recorder for Measuring Thermocouple Temperatures During Test-Plane Flights. J. M. Stein, A. J. Williams, Jr., and W. R. Clark. It is explained that the measuring of the exhaust-gas temperatures in flight-testing large planes requires the use of thermocouples of special design, as well as an instrument capable of recording rapidly, accurately, and directly a large number of temperatures. A description is given of a multiple-point null potentiometer for this purpose, which accommodates 140 thermocouples and is stated to record each temperature in 1.63 sec. Flexible arrangements are provided for switching the numerous thermocouples; this switching may be operated manually by push-button control or automatically by the recorder. Operating characteristics and performance in flight tests are discussed. *Transactions of the A.S.M.E.*, May, 1944, pages 271–275, 7 illus.

Tools and Equipment

Precision Angle Plates "Bypass" Trigonometry. The construction, operation, and advantages of a number of instruments that obviate the need for mathematical calculation in angle measurement are described. Created by Curtiss-Wright employees, the devices include: a dial angle plate for obtaining compound angles in a range sufficient for all practical applications; a simplified sine bar for eliminating angle allowance; a compound-angle determinant, composed of a sine bar attached to a base, for determining foreshortened angles without mathematical com-



American aircraft have it and are demonstrating that fact on a day after day, round the clock schedule because small aircraft parts as well as large are built on a top quality basis.

Flex-O-Tube hose assemblies, with which the Pan-American Atlantic Clipper is equipped, are a typical example of this. Each of these Flex-O-Tubes is engineered, manufactured and tested for a specific application. They are important small parts.

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putation; and a compound-angle plate assembly, known as the Magnasine, which incorporates the compound-angle determinant. *Aviation*, May, 1944, pages 156, 161, 263, 6 illus.

Designing Airframe Assembly Tools. A. S. Turner. It is noted that the problem of the tooling section of the air-frame manufacturing organization is to provide assembly tools that will unite the components produced by the production organization, through successive stages of subassembly and assembly, into the completed airplane. It is stated that this is best begun by fabricating a master tool for each of the major components. *Industrial Aviation*, June, 1944, pages 7–9, 5 illus.

Servicing Civil Aircraft. Part I. The first part of an article describing some of the more interesting machines and apparatus produced by the equipment section of the British Overseas Airways Corporation for the repair of aircraft, aircraft engines, propellers, and auxiliary equipment. This installment discusses a universal testing machine for testing starting motors and the blade-feathering pumps attached to them; a demountable work stand for servicing aircraft; a twisting machine for restoring the correct helix angle of propeller blades that have been damaged; and a tester for the gyro horizon indicator and directional gyro. *The Engineer*, April 28, 1944, pages 324–326, 5 illus.

Tools. A series of notes about the construction, operation, uses, and care of hole-cutting tools. The following are indicated as the important considerations governing the selection of hole-cutting tools: (1) the eccentricities of the substance being worked; (2) the availability of proper equipment; (3) the speed required to meet production schedules or for proper integration of the operation with others; (4) location and position of the material when the hole must be cut; (5) the allowable tolerance in the finished hole; (6) the problem of providing tools that can be readily used and kept in good running order by inexperienced mechanics. *Air Tech*, June, 1944, pages 55, 56,4 illus.

An Inexpensive Photometer for Metallographers. P. A. Haythorne and R. W. Powell. A description is given of a photometer arrangement that is low in cost and especially adapted to metallographic functions. In considering the application of the photometer to photomicrography, the requisites of a high-quality photomicrograph are reviewed. It is found that the instrument saves time and furnishes consistently uniform and well-exposed negatives. Operational and constructional details of the instrument are given. *The Iron Age*, May 11, 1944, pages 66–69, 9 illus.

Drilling Aircraft Channels. The application of portable pneumatic equipment for drilling the flanges of long air-frame channels is described. The article also includes brief data about the small Supermite drills that are used. *Aircraft Production*, May, 1944, page 229, 2 illus.

Training

Torpedo Training and Tactics. Air Commodore J. L. Vachell. As the result of a visit to a Fleet Air Arm torpedo-training school, the writer offers some observations on the aircraft-torpedo tactics that are taught by this branch of the British Services. He discusses the diving approach that is the basis of the Naval training, comparing the techniques employed with those used by the Royal Air Force, and briefly reviews the preparatory training that is given to the crews of F.A.A. torpedo aircraft before they enter school. In conclusion, he indicates the possible effects of future aircraft development upon torpedo tactics. *The Aeroplane*, April 14, 1944, pages 416, 417, 4 illus.

Riveters Good After 8-Day Training. J. E. O'Brien. A description is given of the training schools that the Chrysler Corporation is operating in order to maintain its labor supply. Two-shift schools at three plants are producing skilled workers, most of whom are women. Practical examples are used as an aid in teaching workers the use of tools, and lectures tell what each product does to help the war effort. Orientation periods help to relieve the initial strangeness of new employees. *Wings*, June, 1944, pages 1054, 1055, 4 illus.

Hold Back the Wind. William D. Strohmeier. Advice is given to instructors on procedures for teaching the student pilot how to land. Designating the basic techniques for landing as simply a matter of touching down and taxiing straight, the writer explains how the student should be schooled in stalls (particularly the power-off stall with the nose brought up to landing attitude) for touching down and in proper rudder work for taxiing. He notes the sense of feel, timing, and coordination that must be instilled in the student, and stresses the importance of developing the ability for learning landings while doing general air work. In discussing the psychologic aspects of handling the problem, certain rules of conduct are laid down for the instructor. *Air Facts*, June, 1944, pages 29–34.

Permanent Pilot Supply. W. L. Jack Nelson. The Assistant Executive Director of Training for the Civil Aeronautics Administration War Training Service outlines a training system by which the United States could maintain a reserve force of trained pilots after the war. He suggests that a Joint Aviation Training Committee be established, comprising a representative of the Army Air Forces, a representative of Naval aviation, and a representative of the Civil Aeronautics Administration. This committee would coordinate all of the essential facilities in this country necessary to train each year a sufficient number of young pilots —enrolled in some form of Aerial Reserve Training Corps—to protect the United States against military attack. It is proposed that between 25,000 and 450,000 college freshmen be enrolled in the program of flight training at Federal expense. After completing his course, each pilot would be required to become affiliated with a flying organization that would be maintained in each locality, and to do enough flying each year, until he reaches his 28th year, to maintain his skill. *National Aeronautics*, May, 1944, pages 13, 14, 62, 1 illus.

Celestial Navigation Trainer. Clyde Kennedy. A detailed description of the purpose, construction, and operation of a new device for affording practice in celestial navigation under simulated flight conditions. Developed by the manufacturers of the Link Trainer for pilots, the Celestial Navigation Trainer has a fuselage that operates in a manner similar to that of the pilot-type Link but incorporates features that represent the ground beneath the plane and the sky above it. In addition to the pilot, the Celestial Navigation Trainer carries a navigator, wireless operator, and bombardier. A schematic drawing of the trainer is shown. *Canadian Aviation*, May, 1944, pages 54, 55, 78, 3 illus.; "Flying in a Silo," *Air Pilot and Technician*, May, 1944, pages 21–23, 7 illus.

The Student Pilot and the Controls. Wolfgang Langewiesche. First of a series of articles in which the writer offers ideas for improved methods of instructing the student pilot in the use of the stick, rudder, and throttle. Not only does he advise instructors how to interpret correctly the functions of the controls for the student, but he also suggests ways in which he believes the arrangements of the controls in the airplane might be more efficiently designed.

This initial article is concerned mainly with the rudder. In teaching the student the purpose and use of the rudder, the writer advises that the instructor concentrate on the effect of the rudder as the balance control. Secondary to this, he suggests that the rudder might be defined as the "yaw preventer," although he points out that the latter explanation has certain disadvantages. The need for improved training devices for rudder practice is also discussed and the writer's ideas as to the construction of such equipment are submitted. *Air Facts*, June, 1944, pages 66–76.

Specialized Educational Posters. A poster campaign that highlights faulty working methods and common errors in the handling and storing of materials is described. Photographs of the errors are displayed in appropriate areas at the Chicago plant of Douglas Aircraft Company. Illustrations of the posters are shown and the results of the campaign are outlined. *Industrial Aviation*, June, 1944, pages 30, 31, 67, 2 illus.

Warfare

R.A.F. Over Burma. An account of the activities of the R.A.F. operating from Bengal and Assam against the Japanese in Burma. The report deals with the problems of vast distances,

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Air commerce begins and ends on the ground . . . and its roots already reach deep into many a small American community.

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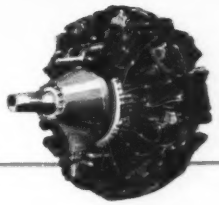

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supply, maintenance, organization, training, strategy, climate and weather, politics, and morale which beset the British air forces operating in this area. It relates the work of bomber, fighter, and night-fighter groups and also analyzes the tactics and strength of the Japanese air forces against which these groups are fighting. Descriptive data are given on several Japanese airplanes, including the Mitsubishi Army 97, Kawasaki Army 99, and the Army 00 Dinah medium bombers; the Nakajima Army 01, Mitsubishi Navy 00-1 and 00-2. An editorial note is appended containing comments about newer Japanese aircraft including the Nakajima Army 03 fighters, an unnumbered fighter of Kawasaki design, and the Mitsubishi Army 00 long-range bomber. *The Aeroplane*, April 7, 1944, pages 385-388, 7 illus.

Formation Fighting Problems. By A. F. An exposition of some of the principles governing formation combat-flying tactics. The writer analyzes formation flying methods and investigates the formations that present opportunities for contriving a superior concentration on enemy flying forces. Both the offensive and defensive aspects of the problem are considered. *Aeronautics*, May, 1944, pages 36–41, 3 illus.

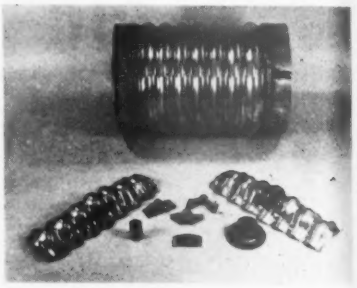
Welding

Atomic-Hydrogen Arc Welding in Aircraft Production. William J. Van den Akker. Atomic-hydrogen welding of the light-gauge materials used in the aircraft industry, as carried out by the Ryan Aeronautical Company, is described. Difficulties that had to be overcome when early attempts to use the process were made are outlined. The welding of stainless steel is discussed. It is stated that the methods now in use with the atomic-hydrogen welding process demand a slower welding speed than was used earlier, yet this is still more than twice as fast as a competitive process.

Techniques of the method are described. Higher hydrogen pressures and a higher current are used in tacking. The tungsten electrodes are adjusted so that the arc fan can be rotated to almost any direction. Types of joints welded with the process include lap, fillet, flange, seam, edge, and corner. Reference is made to the strength of the final bond obtained with the process. The use of the atomic-hydrogen process for the welding of low-carbon steel sheet is discussed. *The Welding Journal*, May, 1944, pages 408–410, 6 illus.; *Western Flying*, May, 1944, pages 49, 50, 52, 5 illus.

Distribution of Shear Strength of Spot Welds in Various Aluminium Alloys. R. F. Tylecote and Angela Lias (from the German of F. Bollenrath and V. Hauk). The second and concluding part of an article taken from *Zeitschrift für Metallkunde* describes investigations made to determine how the distribution of the shear strength of spot welds is affected by welding conditions in different aluminum alloys. The investigation covered about 10,000 spot welds. The aluminum alloys investigated included those containing magnesium, copper and magnesium, and magnesium and zinc.

Sections of the article discuss the influence of the welding current on strength distribution, the relation of welding current to weld strength, the influence of surface treatment on the mean weld strength, and the influence of cold-working on the mean weld strength. Other sections consider the weld strength and distribution in sheets from different producers, as well as the influence of the type of welding machine on the distribution of weld strength. *Sheet Metal Industries*, May, 1944, pages 883-886, 888, 11 illus.



Component parts of an arc-welded corrugated boiler used in the heating system of DC-3 United Air Lines transport planes.

Arc Welding in Airplane Boiler Fabrication. H. A. Lebert and S. B. Willoughby. An account of how arc welding is used in the fabrication of the special corrugated stainless-steel boiler used in the heating system of DC-3 United Air Lines transport planes. The boiler was developed to overcome troubles caused by engine vibration. It is made from a sheet of stainless steel, rolled into cylindrical form. The seam is arc welded, and the corrugations are then rolled into the welded cylinder. The process, which has reduced cost and labor operations to a minimum, is described in full. *The Welding Journal*, May, 1944 pages 434–437, 11 illus.

Miscellaneous

Seventy Ninth Annual Report of the Council of The Royal Aeronautical Society, 1943–1944. The main part of this issue is given to the 79th annual report of the Council. It contains a review of the activities of the Society for the year and the financial statement as of December 31, 1943. *The Journal of The Royal Aeronautical Society*, April, 1944, pages 75–91.

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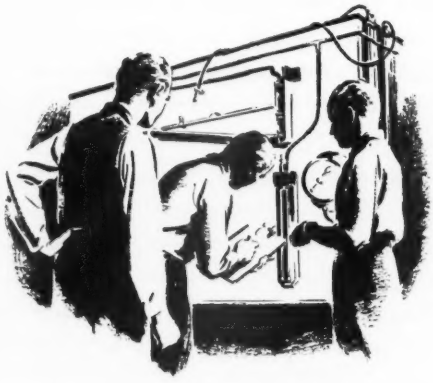

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"But these by themselves are not enough to usher in the age of freight-by-air.

"We must also build a locomotive of the air designed to draw a train of gliders. The glider train will fill a gap in air transportation because a glider can take smaller loads than a plane; and, by adding or subtracting gliders to the train, adjustments can be made to cargo demands with greater economy.

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"The freight-plane will never drive the train or the ship out of business. But it will become a vital part of distribution. Never bet in America that a thing can't be done."

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Source Material

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The prices listed are for yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The AAFSATONIAN, School of Applied Tactics, Army Air Forces, Orlando, Fla.

The Ace-Pursuiter, Special Service Office, Paine Field, Everett, Wash.

Aero, Aero Division, Minneapolis-Honeywell Regulator Co., 2753 4th Ave., S., Minneapolis 8, Minn.

Aero Digest, 515 Madison Ave., New York 22, N.Y., $3.00.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York 7, N.Y.

Aero Products, 271 Madison Ave., New York 16, N.Y.

Aero Research Technical Notes, Aero Research Ltd., Duxford, Cambridge, England.

Aero Time, Basic Flying School, Army Air Forces, Gunter Field, Ala.

Aerodrome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry. The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1.

Aeronáutica, Avenida de Mayo 1370, Buenos Aires, Pesos 4.50.

Aeronáutica Argentina, Casilla de Correo 1897, Buenos Aires, Pesos 8.00.

Aeronautical Briefs, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 6, D.C.

Aeronautical Engineering Review, 1505 RCA Bldg. West, New York 20, N.Y., $3.00.

Aeronautics, Tower House, Southampton St., Strand, London, W.C.2, 26*s.* 6*d.*

Aeronautics, A Quarterly Recognition Guide to Operational War Planes, 37 W. 47th St., New York 19, N.Y., $0.25 per issue.

The Aeroplane, Bowling Green Lane, London, E.C.1, 58*s.*

The Aeroplane Spotter, Bowling Green Lane, London, E.C. 1, 8*s.* 8*d.*

Air Base News, Army Air Base, Jackson, Miss.

Air Currents, Army Air Field, Coffeyville, Kan.

Air Facts, 30 Rockefeller Plaza, New York 20, N.Y., $3.00.

Air Force, Army Air Forces, 101 Park Ave., New York 17, N.Y.

The Air Line Mechanic, 155 N. Clark St., Chicago 1, Ill.

The Air Line Pilot, 3145 W. 63rd St., Chicago 29, Ill.

Air Mail Magazine, Newport, Monmouthshire, Wales, 5*s.*

Air News, 545 5th Ave., New York 17, N.Y., $2.00.

Air Pilot and Technician, 515 Madison Ave., New York 22, N.Y., $3.00.

Air Tech, 545 5th Ave., New York 17, N.Y., $2.50.

Air Trails, 122 E. 42nd St., New York 17, N.Y., $2.50.

Air Transport, 330 W. 42nd St., New York 18, N.Y., $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., $5.00.

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, 26*s.*

Aircraft Journal, United Aircraft Corp., E. Hartford, Conn.

Aircraft Production, Dorset House, Stamford St., London, S.E. 1, £1, 14*s.* 6*d.*

The Aircraft Warning Volunteer, First Fighter Command, Army Air Forces, Mitchel Field, N.Y.

Aircraft-Age, 241 Church St., New York 13, N.Y., $0.90.

The AiResearcher, AiResearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif.

Airflow, Academy of Aeronautics, Jackson Heights, N.Y., and Casey Jones School of Aeronautics, Newark, N.J.

Airlanes, 340 W. 57th St., New York 19, N.Y., $2.50.

Air-O-Mech, Army Air Forces, Seymour Johnson Field, N.C.

Airport Manager's Service Bulletin, Aero Insurance Underwriters, 111 John St., New York 7, N.Y.

Airport Newsletter, Bendix Bldg., Los Angeles 15, Calif., $15.

Airpost Journal, Albion, Pa., $2.00.

The Air-Scoop, Army Air Base, Pueblo, Colo.

Alamogordo Blockbuster, Army Air Base, Alamogordo, N.M.

The Allis-Chalmers Operation and Maintenance Review, Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wis.

Allisonews, Allison Division, General Motors Corp., Indianapolis, Ind.

Aluminum News-Letter, Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh 19, Pa.

AM, Army Air Field, Lincoln, Neb.

American Association for the Advancement of Science, Bulletin, Smithsonian Institution Bldg., Washington 25, D.C., $1.00.

American Aviation, 1317 F St., N.W., Washington 4, D.C., $3.00.

American Aviation Daily, 1317 F St., N.W., Washington 4, D.C., $1.70 (includes International Aviation, foreign news supplement).

American Aviation Directory, 1317 F St., N.W., Washington 4, D.C., $7.50.

American Aviation Sky-Gest, American Aviation Corp., Jamestown, N.Y.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., $3.00.

American Meteorological Society, Bulletin, Milton, Mass., $3.50.

The American Pilot, 1170 Broadway, New York 1, N.Y.

American Society for Testing Materials, Bulletin, 260 S. Broad St., Philadelphia 2, Pa., $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., $12.

Anahuac, Mexico, D.F., $6.00 (Mex.).

Army News, Bureau of Public Relations, War Dept., Washington 25, D.C.

Army Ordnance, 705 Mills Bldg., Washington 6, D.C., $4.50.

Astronautics, 130 W. 42nd St., New York 18, N.Y., $3.00.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 39, Pa., $1.00.

Automotive News, 5229 Cass Ave., Detroit 2, Mich., $4.00.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich.

Avia, Belgrano 471, Piso 3°, Buenos Aires, Argentina, Pesos 6.00 *m/n.*

Aviação, R. Uruguiana 104, 4°, Rio de Janeiro, Brazil, $4.00 (Reis).

Aviación, 416 W. 8th St., Los Angeles, Calif., $1.00.

Aviation, 330 W. 42nd St., New York 18, N.Y., $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., $2.00.

Aviation Bulletin, British Aviation Insurance Company Ltd., 500 Place d'Armes, Montreal, Quebec.

Aviation Equipment, 1170 Broadway, New York 1, N.Y.

Aviation Maintenance, 205 E. 42nd St., New York 17, N.Y., $5.00.

Aviation News, 330 W. 42nd St., New York 18, N.Y., $5.00.

Aviation Progress, Board of Supervisors of Los Angeles County, Los Angeles, Calif.

Aviation Review, 31 Willcocks St., Toronto, $3.00.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill.

Aviation Writers Association, Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y.

Bakelite Review, Bakelite Corp., 30 E. 42nd St., New York 17, N.Y.

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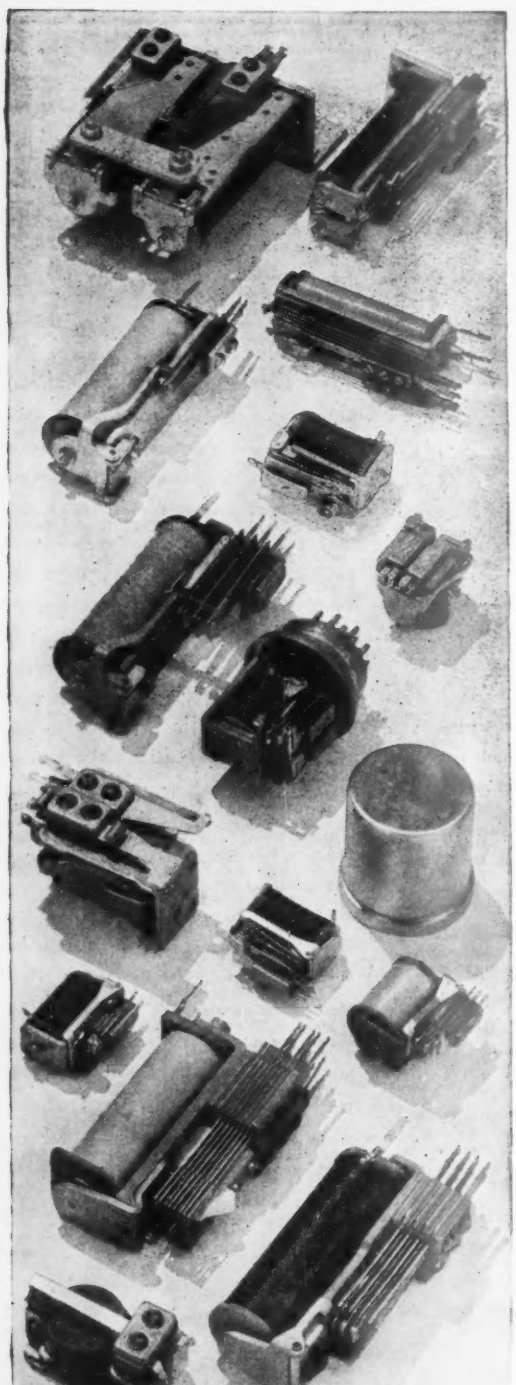

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U. S. Air Services, Transportation Bldg., Washington 6, D.C., $3.00.

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U. S., N.A.C.A., Technical Memorandums, National Advisory Committee for Aeronautics, Washington 25, D.C.

U. S. Naval Institute, Proceedings, Annapolis, Md., $5.00.

U. S. Steel News, U. S. Steel Corp., 436 7th Ave., Pittsburgh, Pa.

Universal Airline Schedules, 139 N. Clark St., Chicago 2, Ill., $5.00.

Universal Engineering Digest, Universal Trading Corp., 630 5th Ave., New York, N.Y.

Upcheck, Lewis School of Aeronautics, Lockport, Ill., $3.00.

The Valve, Wilcox-Rich Div., The Eaton Mfg. Co., Battle Creek, Mich.

V.D.I. Zeitschrift, Edwards Brothers, Inc., 300 John St., Ann Arbor, Mich., $19.

The Volunteer, Nashville Div., Consolidated Vultee Aircraft Corp., Nashville, Tenn.

Vox Prop, Air Service Command, Army Air Field, Rome, N.Y.

Vox Prop, American Propeller Corp., Toledo, O.

The Waco Word, Waco Aircraft Co., Troy, O.

War Medicine, 535 N. Dearborn St., Chicago 10, Ill., $6.00.

War Production Drive, Summerill Tubing Co., Bridgeport, Pa.

Warplane Production, Aircraft War Production Council, Inc., Hollywood Professional Bldg., Los Angeles 28, Calif.

Washington News Letter, 1025 Connecticut Ave., Washington 6, D.C., $2.00.

The Wasp Nest, Pratt & Whitney Aircraft Corp. of Missouri, Kansas City, Mo.

Weight Engineering, Society of Aeronautical Weight Engineers, Inc., 143 N. Brand Blvd., Glendale 3, Calif., $1.75.

The Welding Journal, 33 W. 39th St., New York 18, N.Y., $5.00.

West Coast Air Mail Society, Bulletin, 4142 26th St., San Francisco 14, Calif.

Western Flying, 304 S. Broadway, Los Angeles 13, Calif., $2.00.

Wheelco Comments, Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill.

Williams Field Airfax, Army Air Forces, Williams Field, Chandler, Ariz.

Wing Tips, Army Air Field, San Bernardino, Calif.

Wing Tips, Pilot School (Specialized Two Engine), Mather Field, Sacramento, Calif.

The Wingfoot Clan, Goodyear Aircraft Corp., 1217 E. Market St., Akron, O.

Wings, McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N.Y.

Wings, 1-5 Marion St., Wellington, N.Z., 10s.

Wingspread, Army Air Forces, Peterson Field, Colorado Springs, Colo.

Wing-Tips, Mid-Continent Airlines, Inc., Waltower Bldg., Kansas City, Mo.

Wing-Tips, Waco Army Flying School, Waco, Tex.

Wright at the Moment, Wright Aeronautical Corp., Paterson, N.J.

Yuma Actioneer, Army Air Field, Yuma, Ariz.

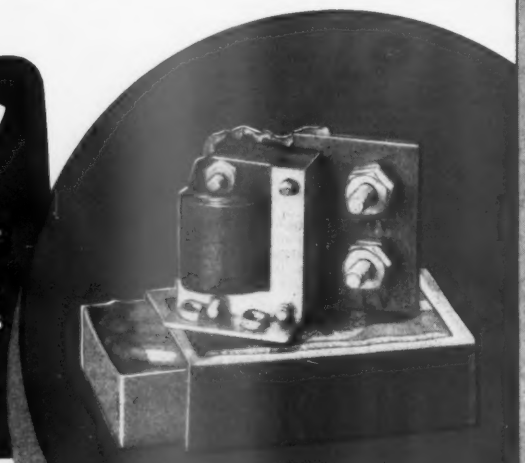
Zoom, Basic Flying School, Army Air Forces, Bainbridge, Ga.

2 OUNCES THAT MAY SAVE YOU 2 POUNDS

New

Autotransformer for operation of 24- to 28-volt, a-c aircraft instruments

—another G-E aid to help you use your a-c power to greatest advantage



6-va rating weighs 2 oz. Size: 1 3/4 by 1 1/4 by 1 1/16 in. (approx)

THIS new autotransformer is designed especially to furnish proper a-c voltage for the operation of 400-cycle aircraft instruments such as the remote indicating compass. Available in two ratings—6 and 12 va—it operates over a frequency range of 380 to 420 cycles, and provides a 28-volt, single-phase output from a 120-volt input.

REPLACES ADDITIONAL INVERTERS—It can be advantageously applied on planes that have a 110- to 120-volt, a-c power source available, thus eliminating the need for additional inverters to supply, from the d-c source, the correct a-c voltage for the operation of these instruments. Its use saves weight and space by making possible the fuller utilization of the already available a-c power source.

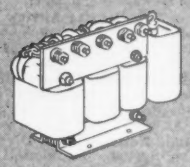
STURDY CONSTRUCTION—The core and coils are impregnated with moisture- and heat-resistant, Glyptal* base, clear varnish. All exposed solder joints are corrosion resistant. The terminal board is constructed of tough, cloth-base Textolite* for resistance to vibration and shock.

These autotransformers will operate efficiently at any altitude, if sufficient ventilation is provided.

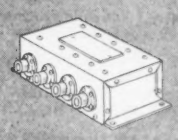
For further information, on this and other G-E transformers for aircraft, ask for the complete set of illustrated bulletins offered at the right. *General Electric Company, Schenectady 5, N. Y.*

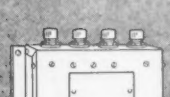
*Reg. U.S. Pat. Off.

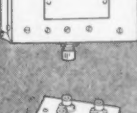
IMPROVE AIRCRAFT ELECTRIC SYSTEMS WITH THESE G-E TRANSFORMERS



3 to 1-, 2 to 3-, and 1 to 3-phase transformers

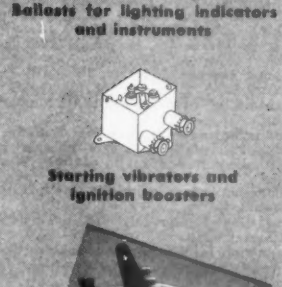






Ballasts for lighting indicators and instruments

Starting vibrators and ignition boosters



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Government Publications

Army Air Forces

Air Power in the Southwest Pacific. Lt. Gen. George C. Kenney. The Commanding General of the Fifth Air Force and Commander of the Allied air forces in the Southwest Pacific reviews some of the operations and tells about air-combat techniques employed in that theater of war. Tracing the constant change of air tactics necessitated in that area, he notes particularly the applications of skip and night bombing. He also describes how planes were modified to meet the peculiar conditions of the Southwest Pacific war front. The planes that are discussed in connection with the modifications are the B-25, B-24, P-39 and P-47. While victories that were won by the use of air power alone are recorded, attention is called also to instances where success was dependent upon the cooperation of both air and ground forces. Air operations at Lae, Salamaua, Papua, Buna, Rabaul, Marilinan, Bismarck Sea, and Cape Gloucester are mentioned. *Air Force*, June, 1944.

Wright Field 10-Ft. Wind Tunnel. Designed for testing models of high-altitude bombers and fighters, a funnel-shaped, 10-ft. wind tunnel that will generate winds of over 600 m.p.h. at temperatures as low as −67°F. is now under construction at Headquarters of the Army Air Forces Matériel Command at Wright Field. The wind velocity will be made possible by using two 20,000-hp. motors to drive the fans and by tapering the tunnel from its maximum cross section to a minimum diameter of 10 ft. at the throat.

Temperature and pressure conditions found at altitudes ranging from sea level to 50,000 ft. will be simulated in the new tunnel. A storage-type refrigeration system will be used to reduce the temperature of the wind to −67°F. Supplementing the 20-ft. tunnel now in operation at Wright Field, the new tunnel will permit tests of an entirely different nature. The older 20-ft. tunnel is an atmospheric tunnel used in testing aircraft and component parts under simulated sea-level conditions. It was not designed, however, to reproduce altitude pressures or temperatures.

The new testing tunnel, built in the shape of a long, narrow rectangle of the closed-return type, will operate at less than one-eighth of atmospheric pressure, approximating pressure conditions found at 50,000 ft. It will aid in making important aircraft modifications necessitated because of high-altitude operations, addition of armament, changes in cowling and other alterations, which exert a direct influence on the speed of the planes and on changes in aerodynamic characteristics. *Army Air Forces Matériel Command.*

Navigation Problems in England. Lt. Ralph N. Phillips. The differences between conditions affecting avigation over England compared with those over the United States are discussed. The topography and the appearance of the land differ markedly from those at home, there being few of the straight, well-defined roads and fences, high-tension power lines, and wide spacings between towns. Because of England's active antiaircraft defense, a deviation of only 1 mile from the course entails the risk of receiving antiaircraft fire. Differences of British maps also are noted, these being drawn to small scales. Because of airplane speed relative to the short distances in England, check points on the maps are difficult to follow. Anecdotes are related from the writer's experiences to illustrate the necessity for relearning numerous rules of avigation.

Precautions necessary when flying bombers in formation and with fighter escort are described, with comments on the results of slight errors in maintaining the course. The particular duties of the navigator are emphasized. *Air Force*, June, 1944.

The Conquest of Fear. Major Arthur Gordon. The causes of, and cures for, operational fatigue and anxiety neurosis in air personnel are explained. Giving reasons why bomber crews are more likely to suffer from nervous reactions than fighter crews, the writer describes the peculiar forces that tend to produce psychic disorders in fliers. On the other hand, he also reviews the stabilizing factors that counteract those forces. Physical and psychic symptoms that denote the approach of operational fatigue are noted, and education, rest, and change are prescribed as the treatment for mild maladjustments of such nature. It is reported that the incidence of anxiety neurosis among American air crews in Britain is remarkably rare. *Air Force*, June, 1944.

"I've Got Wings!" By means of colored humorous sketches and dialogue a booklet of 95 pages is intended to impress the rules of safe flying on the minds of air cadets and other students of flying. Its concluding pages contain two quizzes consisting of 20 questions each, with references to the pages on which the correct answer may be found. A glossary of "slanguage" also is included. Art ideas for the booklet were contributed by personnel of the Air Traffic Control Division of the Civil Aeronautics Administration. With the permission of the Army Air Forces copies of the booklet are being distributed by the Aircraft Owners and Pilots Association to all of its registered pilots. *Army Air Forces, Flight Control Command.*

No Rest for the Luftwaffe. Major Arthur Gordon. Continuing a series of monthly reports on American Air Forces operations in the European theater of war, this article reviews some highlights in the Spring air offensive. The main portion of the discussion is devoted to the work of the British-based fighters and the long-range support they gave to bombers raiding Germany. The P-47, P-51, and P-38 are named as the three basic fighter airplanes used in this work. The performance records of American bombers based both in Britain and in Italy, during the Spring of 1944, are noted. *Air Force*, June, 1944.

On the Target. Capt. L. P. Bachmann. An important problem in preparing for the first missions against Hollandia, in New Guinea, was solved by oblique-approach sketches, a new technique recently developed. It is stated that the method does not take the place of photographs but that the oblique sketches are used to supplement photography. The main purpose of the oblique-approach sketch is to show the details of terrain that has not been mapped or thoroughly photographed. Another advantage is that unimportant details can be eliminated from the sketch, whereas a photograph sometimes shows so much detail that it can be confusing. All possible sources of information are used in making these sketches, so that important points can be brought out to facilitate the use of the sketches by personnel untrained in reading maps and photographs. *Air Force*, June, 1944.

In the Eyes of the Flyers Your Planes Are Alive. A 14-page illustrated booklet contains stories from War Department records intended to stimulate the quantity and quality of production on the part of aircraft workers. The stories are about the exploits and accomplishments of airplanes that have been in combat and the men who fly them, showing how these planes have withstood damage

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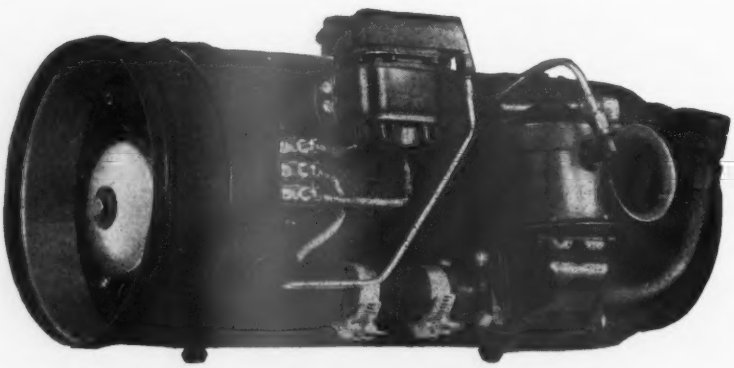
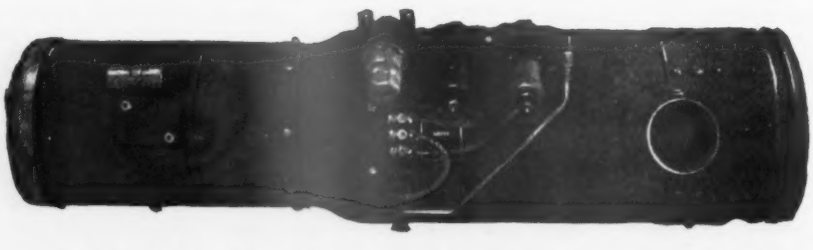


Entirely independent of the engine, South Wind model 906-A-1 is ram-air operated with rated output of 50,000 Btu/hr. It is 7 inches in diameter and 17⅜ inches long—with weight of approximately 17 pounds, including filter and valves.



Designed especially for fan operation, the South Wind Model 906-E weighs only 15 pounds, less fan. With the fan shown, weighing 7 pounds, the heat output is approximately 45,000 Btu/hr.

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SOUTH WIND HEATER

Simpler! Surer! Hotter!

ALREADY a record-holder for dependability and long life, Stewart-Warner's never-ending development work has made this remarkably compact, light-weight South Wind model 906 an even finer unit than before.

In life tests—still uncompleted—two of these South Winds have already passed the 1900-hour mark in excellent operating condition.

In the improved version . . . 906-A-1 . . . the shut-off and restriction valves and filter are combined into a single, simpler unit, eliminating numerous fittings and connections and greatly reducing the chance of foreign matter getting into the system. In addition, the new valves have synthetic rubber instead of metal seats, making them relatively immune to leakage due to foreign material lodging on the seats. All terminals are now enclosed.

Starting characteristics have been further improved. In tests at −70° F., the heaters started consistently at 29,000 feet with 87-octane gasoline, and at 30,000 to 31,000 feet with 91-octane fuel.

Although rated at 50,000 Btu/hr. output, substantially greater output is possible under certain conditions. When total inlet air pressure of 10 inches of water is available, output of 80,000 Btu/hr. has been attained *with no increase of maximum metal temperatures above those at normal rated output.*

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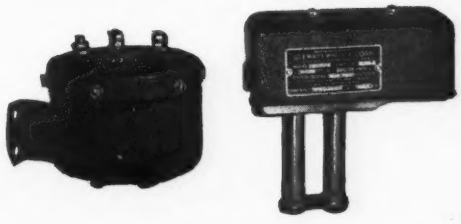
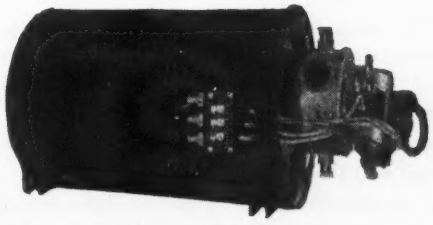


Stewart-Warner South Wind Thermo-Switch and Duct Pressure Switch are light-weight controls, quickly adjustable to desired settings, with special design and operating advantages developed by South Wind engineers. They are engineered to operate as a team with the 906-A-1 heater, and provide fully automatic regulation of fuel and ignition, so heater operation can be controlled from a single switch.



NEW! Model 911 South Wind—ram-air operated—10 inches in diameter and weighing but 23 pounds — gives up to 250,000 Btu/hr. output . . . more heat per pound and cubic inch than ever attained before!

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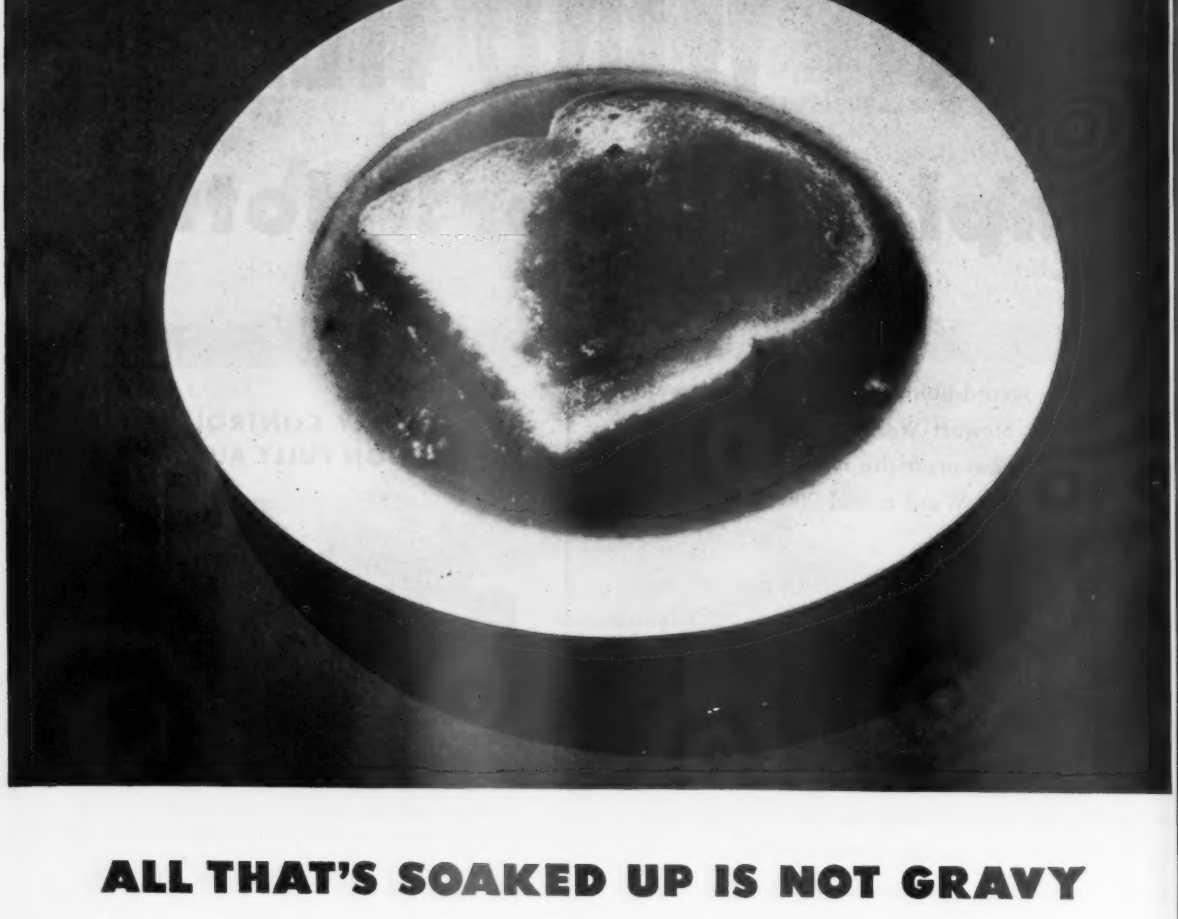

ALL THAT'S SOAKED UP IS NOT GRAVY

PETROLEUM products, for example, may be absorbed by the thousands of resilient parts in a plane—oil seals, hose, accumulator bags, packing, gaskets, grommets, diaphragms—just as gravy is absorbed by bread. This absorption either adds dead weight not included in the original design calculations, or swelling of the liners reduces the capacity of hose, accumulator bags or other similar parts.

Hycar synthetic rubber with its light weight and superb resistance to oil to keep it light, provides protection against increased weight and decreased capacity not offered by any other comparable material. Hycar is 15% to 25% lighter than many other synthetic rubbers and retains this important quality throughout its long life. Oil-swell can be controlled closely to insure dimensional stability of parts.

Hycar has an operating range of −65° to +250° F. and abrasion resistance 50% better than natural rubber. Unlike many other oil-resistant synthetic rubbers, Hycar has a minimum tendency to cold flow after taking the initial deformation, even at elevated temperatures.

You need these qualities in resilient materials used in the presence of oil and gasoline. Let our technical service staff help solve your individual problems. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

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Synthetic Rubber

inflicted by the enemy and have been victorious in aerial combat.

Sky Quirks. Lt. Herbert G. Dorsey Jr., and Lt. Oscar Shaftel. A discussion of some atmospheric phenomena that affect avigation in arctic and desert regions. Among the problems examined are those caused by the extreme transparency of the air in those areas, dust and sand storms, ground haze resulting from a combination of low cloudiness and new snow, mirages, etc. *Air Force*, June, 1944.

Army Service Forces

Adjustment of Production "Cutbacks" is a booklet illustrated by sketches and prepared by the Army Service Forces. Its purpose is to outline, simply and graphically, the careful consideration and detailed planning that the Army accords to any necessary reduction in production programs and resultant cancellation of contracts.

It explains the necessity for changes in production plans and outlines the procedures of the Army Service Forces for the implementation of changes in its programs.

Navy Bureau of Aeronautics

BuAer-ASO Packing Provisions No. 1 is a leaflet of 4 pages giving the requirements of the Naval Aviation Supply Depot for the packaging, packing, marking, and transporting of materials for delivery to the Bureau of Aeronautics or the Aviation Supply Office. The requirements apply to all items in a procurement document in which these provisions are referred to or incorporated.

Copies of these provisions and of the specifications referred to may be obtained from the Bureau of Aeronautics or the Aviation Supply Office upon request. *Aviation Supply Office, Naval Aviation Supply Depot*, Philadelphia.

Navy Department

Four new motion-picture shorts, produced by the Industrial Incentive Division of the U.S. Navy, are now available for showings to war plants. They are:

Behind Nazi Guns (20 min.; 16 or 35 mm.)—The inside story of Germany's industrial war power today. Through captured enemy film and other footage, the picture reveals working conditions in bombed Germany and emphasizes to the American worker the challenge that has been flung at him by his "opposite number" on the Nazi workbench. It is narrated by William L. Shirer.

The Battle Against Shop 13 (15 min.; 16 or 35 mm.)—A typical American boy leaves his war job to become a Navy aerial gunner. An unexpected climax drives home poignantly a reason why the men at the fighting fronts will be given complete production backing.

Your Ship in Action (10 min.; 16 mm. only; in color)—The story of a fighting ship from the time of its launching to its first baptism of fire in the Pacific.

For Distinguished Service (18 min.; 16 or 35 mm.)—Particularly designed for exhibition in the petroleum industry, this picture shows the pipe lines of victory extending from the "cat-crackers" to the far-flung battle zones. *Industrial Incentive Division.*

Civil Aeronautics Board

A list of the total number of transport aircraft of all types in domestic service on commercial air lines, compiled by the Public Information Section of the Civil Aeronautics Board, shows that there were 214 such aircraft in service as of May 18, 1944, compared with 314 on May 18, 1942. The report gives the number of aircraft operated on those dates by 16 domestic air lines.

Civil Aeronautics Administration

Establishment of an Urban Planning Section to assist metropolitan areas in the development of comprehensive airport plans has been announced by the Civil Aeronautics Administration. The method being used emphasizes the needs of private flying. First, the planners determine where the potential plane owners live, with family income the criterion, and then find the nearest undeveloped area within which to search for a suitable airport site. Before final choice of site, consideration is given to related elements in the community plan, such as highways, railroads, waterways, etc., and to the existing and proposed pattern of airways, major airports, and feeder-line routes.

Creation of the Urban Planning Section rounds out a three-point program of the C.A.A. for furnishing airport-planning assistance to communities desiring it. Units have already been set up to compile and furnish information concerning airport management and design of airport buildings. The three units will supplement the broader activities of the C.A.A. in surveying the needs of a national airport system and formulating design and construction standards.

Maintenance, Repair, and Alteration of Certificated Aircraft, Aircraft Engines, Propellers, and Instruments. This manual contains material interpreting and explaining the maintenance, repair, and alteration requirements of the Civil Air Regulations, Part 18. Each section is arranged and numbered to correspond with the Civil Air Regulations, Part 18, pertaining to the same subject, and the pertinent section of the Regulations is quoted ahead of the interpretive material.

The manual includes 133 pages, of which the first 47 are given to text matter in numbered paragraphs as explained above. The next 47 pages contain drawings and instructions for the operation, described in the correspondingly numbered section, to which reference is made. The final 39 pages comprise three appendixes, of which the first gives examples and methods of showing compliance with the requirements in case of special repairs involving aluminum-alloy structures. Appendix II gives information about weighing procedures and check of balance for alterations, and Appendix III contains instructions for splicing aircraft cable. *Civil Aeronautics Manual 18.* For sale by Superintendent of Documents, Washington, $0.50.

Defense Supplies Corporation

The American Republics Aviation Division of Defense Supplies Corporation has made available for general distribution certain statistical excerpts from a confidential survey of "Air Transportation in Latin America," prepared with the cooperation of the Office of Air Transport Information, Civil Aeronautics Board.

Table 1 shows that the total volume of traffic, local and nonlocal, in and to Latin America increased from 20,544,000 ton-miles in 1940 to 61,919,000 ton-miles in 1943 and amounted to 29 per cent of the United States domestic traffic in the latter year. Passenger traffic represented 76 per cent of the total in 1943, cargo 18 per cent, and mail only 6 per cent, as compared with 76 per cent, 7 per cent, and 17 per cent, respectively, on the U.S. domestic system, the relative importance of cargo and mail being reversed. In certain countries cargo ranked with or ahead of passenger traffic in volume. Cargo accounted for 60 per cent of total ton-miles in Central America, 44 per cent in Bolivia, 33 per cent in Colombia, and 28 per cent in Peru. Nonlocal traffic accounted for a slightly higher proportion of the total ton-miles than did local traffic.

Local traffic was about equally divided between South America and Middle America. Two countries, Brazil and Mexico, accounted for over half the total local traffic in 1943.

As an indication of the growth of air transportation in Latin America, it is noted that the total of ton-miles in 1943 was somewhat in excess of the estimated total traffic carried by all European air lines, including their overseas routes to all parts of the world in 1938, the last prewar year. As another illustration of the relative importance of air transportation in Latin America, it is observed that American Airlines, the largest U.S. domestic carrier, flew almost as many ton-miles (in domestic service) as did all of the airlines operating in Latin America in 1943.

Route miles in Latin America are almost three times as great as in the United States, but only half as many miles were flown in 1943. Thus the average frequency of service was only about one-sixth as high as in the United States.

Average passenger fares in Latin America are some 40 per cent above the level of the U.S. domestic system, although they have decreased slightly since 1940. There is considerable variation in tariffs, however, ranging from 3.8 cents per passenger mile in Peru to 16.0

The war won't wait for sunny weather or dry landing strips. Every plane surface must be highly weather-proof. That's why many of the most famous allied fighters and bombers are protected with Berryloid Aircraft Finishes. In thirty years there have been no finer finishes made—none so durable, none so weather-resistant. Peacetime manufacturers will likewise benefit by this dependable quality.

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cents in Venezuela. Cargo tariffs averaged 84.6 cents per ton-mile in 1943, a moderate increase over 1940, accounted for principally by substantial increases in Bolivia and Central America. Peru and Brazil had the lowest cargo tariffs in 1943. In general, fares for nonlocal air travel and express were slightly higher than for local services.

Despite substantial improvement since 1940, utilization of aircraft in Latin America is low, averaging 3.0 hours per plane per day compared with 9.6 hours in the United States in 1943. Foreign-flag carriers averaged only 2.4 hours, as compared with 5.8 hours for U.S.-flag carriers in Latin America. Among the causes of the low utilization of equipment are: low frequency of service, lack of night flying, inadequate maintenance facilities, and the advanced age of many of the planes. Present trends suggest that much higher rates of utilization will be possible within the next few years.

In 1943, 386 planes were in operation in Latin America. Of this total only 57 were U.S.-flag aircraft. There were 246 multiengined planes but only 97 planes were of the modern types manufactured since 1936. Of these, 48 were U.S.-flag aircraft and 20 were registered in Brazil. *American Republics Aviation Division.*

Petroleum Administration for War

100 Octane Fuel is a pamphlet of 25 pages. It describes how 100-octane fuel is made, how much is being produced, what it costs, and numerous other points concerning the manufacture and use of aircraft fuel. The

history of the development of the fuel is traced, and its accomplishments in aerial combat are reviewed. A list of the refiners making the fuel and its components is given. Letters from General Arnold, Admiral King, and other Navy officers containing their comments about the value of the fuel in the war are reproduced.

War Manpower Commission

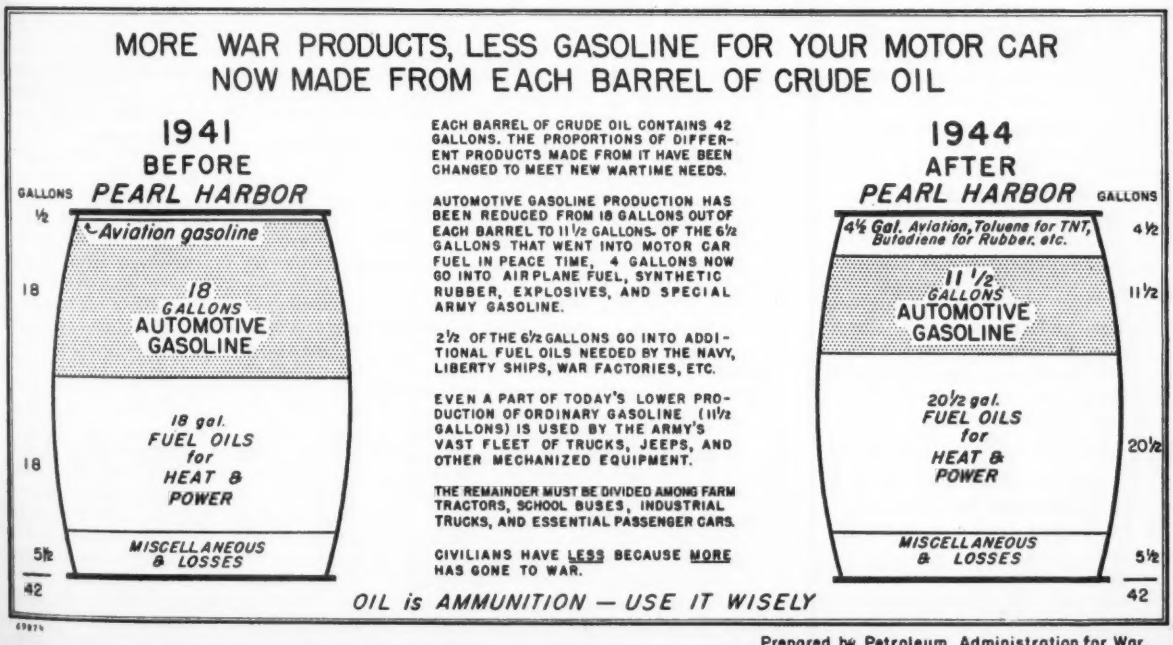
Training Women for War Work is a 19-page booklet containing suggested methods and procedures for training inexperienced women workers. It is based on special studies of job training for women and on reports from field men on training practices that are being applied successfully by war-production plants. The subject is treated under the following headings: Discovering the Needs, Adapting Plant Facilities, Preparing the Plant Personnel, Outlining the Training Program, Preparatory Training, Induction Training, On-the-Job Training, Supplementary Training, Apprentice Training, and Women Counselors. The final pages contain a list of the training assistance available through the agency and a list of its regional representatives. *Apprentice-Training Service, Bureau of Training,* Washington.

State Department

Estados Unidos en la Guerra (The United States in the War). This booklet of 24 pages, with Spanish explanatory notes and captions, contains sketches depicting many phases of the war activity of the United States. It shows the contributions of the citizens at home and the production of materials in American plants, as well as some of the direct military actions on land, on sea, and in the air. *Office of the Coordinator of Inter-American Affairs.*

State of Michigan

The Michigan Airport Construction and Employment Program describes a plan that includes projected extension of 129 existing municipal and county airports plus 170 new airports, landing fields, and landing strips. It is tentative and may require additional municipal airport locations later. In some regions single airports have been suggested as efficient and economical in serving several smaller cities. No specific recommendation is made for the airport system of the metropolitan areas of Detroit. Moreover, no consideration has been given to supplemental private fields, many of which will be developed for training and flying-club purposes. A suggested plan of recreational fields and


GASOLINE GOES TO WAR
MORE WAR PRODUCTS, LESS GASOLINE FOR YOUR MOTOR CAR
NOW MADE FROM EACH BARREL OF CRUDE OIL
1941
BEFORE
PEARL HARBOR
GALLONS
½
Aviation gasoline
18
18 GALLONS AUTOMOTIVE GASOLINE
18 gal. FUEL OILS for HEAT & POWER
18
5½
MISCELLANEOUS & LOSSES
42
EACH BARREL OF CRUDE OIL CONTAINS 42 GALLONS. THE PROPORTIONS OF DIFFERENT PRODUCTS MADE FROM IT HAVE BEEN CHANGED TO MEET NEW WARTIME NEEDS.
AUTOMOTIVE GASOLINE PRODUCTION HAS BEEN REDUCED FROM 18 GALLONS OUT OF EACH BARREL TO 11½ GALLONS. OF THE 6½ GALLONS THAT WENT INTO MOTOR CAR FUEL IN PEACE TIME, 4 GALLONS NOW GO INTO AIRPLANE FUEL, SYNTHETIC RUBBER, EXPLOSIVES, AND SPECIAL ARMY GASOLINE.
2½ OF THE 6½ GALLONS GO INTO ADDITIONAL FUEL OILS NEEDED BY THE NAVY, LIBERTY SHIPS, WAR FACTORIES, ETC.
EVEN A PART OF TODAY'S LOWER PRODUCTION OF ORDINARY GASOLINE (11½ GALLONS) IS USED BY THE ARMY'S VAST FLEET OF TRUCKS, JEEPS, AND OTHER MECHANIZED EQUIPMENT.
THE REMAINDER MUST BE DIVIDED AMONG FARM TRACTORS, SCHOOL BUSES, INDUSTRIAL TRUCKS, AND ESSENTIAL PASSENGER CARS.
CIVILIANS HAVE LESS BECAUSE MORE HAS GONE TO WAR.
1944
AFTER
PEARL HARBOR
GALLONS
4½ Gal. Aviation, Toluene for TNT, Butadiene for Rubber, etc.
4½
11½ GALLONS AUTOMOTIVE GASOLINE
11½
20½ gal. FUEL OILS for HEAT & POWER
20½
MISCELLANEOUS & LOSSES
5½
42
OIL is AMMUNITION — USE IT WISELY

1941 figures are for the entire year; 1944 figures are for the month of January.

Prepared by Petroleum Administration for War.
Division of Research

After The Others Failed . . .

SpeedWay's "know how" was able to develop new gear-motor designs for the Armed Forces that did the required job. Today, expanded needs for these motors take SpeedWay's capacity, as well as the capacities of other large motor manufacturers, *working to SpeedWay Specifications.*

If you need motors or gearmotors for a standard or special application, bring your problem to SpeedWay. Motor outputs range from 1/200 to 1/2 hp. Unlimited gear ratios available from stock gears. Write for our recommendations on your war or postwar problem.

Write for SpeedWay's new Motor Bulletin showing standard A.C., D.C., and Universal Motors and gearmotors.

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OPPORTUNITY
in Sales Engineering

We feel we have an opportunity for a Sales Engineer in the aircraft industry. The requisites of the position include an adequate knowledge of mechanical engineering; the ability to interview the presidents of aircraft companies; a sound knowledge of present industrial problems and constructive post-war plans.

The potentialities of the position are excellent, and the salary commensurate. However, proper clearance with the War Manpower Commission is necessary.

If you possess the above requirements and you are interested, will you kindly send a résumé of your qualifications to: Box 231, Institute of Aeronautical Sciences.

service fields for state departmental operation will be submitted later.

The financing of this plan is based upon the municipalities' acquiring the site property and financing their own buildings, since the buildings provide a source of revenue in rentals. By this plan the state should finance on a matching basis the landing-field improvements, such as grading, drainage, runway surfacing, and lighting. The state's share of this plan is approximately $25,000,000. Any federal assistance, in addition, would permit a more rounded plan and a development of fields more consistent with the early postwar air transportation requirements. *Michigan Board of Aeronautics.*

New York State Department of Commerce

As a part of a campaign for industrial development undertaken by the Department of Commerce of New York State, an industrial book titled *New York Means Business* visualizes New York as the center of postwar air traffic. Aviation is regarded by the Department as a leading industry for the state as well as for the nation. The book refers to the part played by the aviation industry during the war and predicts an air-minded world after the war. It shows that prior to the war five major air lines served eight key cities in New York State. With various feeder air lines, these major routes are expected to serve the entire state in postwar periods. The book contains several new maps of interest to the aircraft industry, one being a map of the air facilities of the state expected to be available for development after the war.

British Information Services

Estimation and Prevention of Leak Drag. G. N. Patterson. Tests in the 24-ft. tunnel at the Royal Aircraft Establishment have shown that the leakage of air into and out of an airplane may lead to a large increase in the drag and that the drag may be reduced by suitable bulkheads. Model tests were desirable to provide a basis for estimating the drag of a combination of leaks, to investigate the conditions that produce a large leak drag, and to determine further methods of correcting these conditions. The experiments were made with a one-fifth scale model of a fighter. Leaks were tested in combination and separately over a wide range of internal pressures, the latter being controlled by a pressure system connected with the model. Relationships to be used as a basis for estimating leak drag were obtained. The following conclusions were reached:

With respect to the estimation of leak drag: (1) The drag of a group of leaks is almost equal to the sum of the drags of each leak measured separately at the same internal pressure as that of the group—i.e., the interference between leaks is small. (2) The drag of a single leak is a function mainly of the velocity of the flow through the leak, the area of leakage, and the direction in which the air issues at the leak. Therefore, leaks may be classified according to the direction in which they open, and the drag of each type may then be calculated from a knowledge of the internal and external pressures and the area of leakage. The application of the method of estimating leak drag to various full-scale installations shows reasonable agreement with the measured values. (3) The internal pressure required for the above calculations should preferably be measured in flight. When new designs of airplanes are being considered, the internal pressure can be estimated if the characteristics of each leak are known.

With respect to reduction of leak drag: A large leak drag may be prevented (1) by removing all unnecessary leaks and keeping all unavoidable leaks as small as possible, and (2) separating the unavoidable leaks that register widely differing pressures to prevent a large flow between them. Leaks that register a high internal pressure—i.e., leaks in high-pressure regions or leaks that open forward—should be isolated by bulkheads or made backward-facing. The model tests show that it is sometimes possible for a combination of leaks to produce a drag reduction. This result indicates that aerodynamic suction may be used to prevent separations of the flow and thus reduce the drag. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1883,* British Information Services, New York, $1.90.

British Ministry of Labour and National Service and the Ministry of Production

Interchangeability Media for Airframes Largely Built by Government Trainees. An account of how a British manufacturer of large fixtures and gauges for the assembly of ailerons, wing spars, and other air-frame structures introduced optical measuring methods and a special procedure so that trainee labor could be employed. *Production and Engineering Bulletin,* April, 1944.

Recovery of Oil from Swarf. Results are given of a study of the economies affected in war-production plants by measures for recovering cutting oil from the swarf resulting from machining operations. Suggestions are made for instituting standard procedures for oil reclamation. The advantages are shown to lie not only in the recovery of the oil but in providing better and more useful salvaged material because the chips and cuttings are cleaner and in better condition. A table shows the amounts and percentages of oil recovered, amounting to as much as 83 per cent in a month. Another table indicates that the oil saved from aluminum swarf is greater than that from steel or brass chips and runs as high as 43.9 lbs. of oil from 100 lbs. of broad aluminum swarf. *Production and Engineering Bulletin,* May, 1944.

How Much Cold Can Rubber Stand?

Sub-zero temperatures as low as —120° F. are produced by the machine illustrated. It is a Deepfreeze *"Cascade Unit"* manufactured by the Deepfreeze Division of the Motor Products Corporation of North Chicago, Ill.

This modern testing machine is used by The Ohio Rubber Company to predetermine the cold resistance of every rubber and synthetic rubber compound formulated to meet specifications for parts to be subjected to sub-zero temperatures.

Unless properly compounded to resist extreme cold, soft rubber or synthetic rubber can become as hard and brittle as glass, and as easily shattered. Such failures are prevented at "Ohio Rubber" by the use of the machine illustrated.

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AIRCRAFT TUBING

THINK BEFORE YOU TALK ABOUT WAR INFORMATION. IT MAY SAVE LIVES.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Stick and Rudder

Wolfgang Langewiesche

Contents: How a Wing Is Flown; The Airplane's Gaits; Lift and Buoyancy; The Flying Instinct; The Law of the Roller Coaster; Wind Drift; What the Airplane Wants to Do; That Thing Called Torque; The Flippers and the Throttle; The Ailerons; The Rudder; The Turn; Straight and Level Cruising; The Glide; The Approach; The Landing; The Landing Run; The Dangers of the Air; The Working Speeds of an Airplane; Thin Air.

No analysis of the art of flying ever had behind it a greater wealth of experience. A pilot-instructor with radical ideas of how an airplane flies and what a pilot does when he flies explains why flying is difficult to learn. He appeals to the imagination as well as the skill of the pupil. He attacks many of the preconceived ideas of the theorist or the old-time instructor.

Each maneuver is studied in detail. The pupil is told what may happen to him if he forgets and, by vivid and understandable straight talk, he has each move impressed indelibly on his memory. It is undoubtedly one of the clearest and most sensible books available about flying instruction. Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1944; 389 pages, $3.75.

Bombardment Aviation

Keith Ayling

Contents: Beginnings; World War II Development; Technique; Day Bombing; Night Bombing; Dive-Bombing; Low-Flying Attack; Attack on Ships; Bombs; Bombardment Value; Bombers.

The all-important mission of bombing has been given a complete opportunity to demonstrate its success in the preinvasion period of the attack on the Continent. This book gives the fundamentals of bombing theory and practice and traces the development of bombing techniques. It describes the earliest experiments in dropping bombs from airplanes and the gradual evolution of this devastating new weapon.

The advantages of day bombing as contrasted with night bombing, are discussed. General information is given concerning the methods of carrying out bombing attacks and particular actions are described. The advantages and weaknesses of dive bombing are outlined, its specialized uses are compared with ordinary low-flying attacks. Allied and enemy bombers are compared.

The use of the bomb and the torpedo in attacking ships, together with the various methods of their release, are described. Bombs, bombing aircraft, and an evaluation of the resulting effects of bombardment are discussed in the concluding chapters of the book.

Written by an experienced observer who has had exceptional opportunities for investigation, the book will be useful in acquainting the public with a better understanding of this relatively new weapon of the Air Forces. Military Service Publishing Company, Harrisburg, Pa., 1944; 234 pages, $2.00.

War Below Zero

Col. Bernt Balchen, Major Corey Ford, and Major Oliver La Farge

Contents: Greenland Adventure; The Long Wait; Flight East; Life on the Greenland Ice Cap.

The Army Air Forces were fortunate in having available such an expert and experienced Arctic specialist as Bernt Balchen, who was commissioned a Colonel and sent to assume the protection of Greenland. This little-known operation is described in the first part of this book. It reveals the secret warfare that took place in the Arctic during the first armed conflict with German invaders of the Western Hemisphere. Enemy planes were flying within bombing distance of North America and their submarines were being refueled in Greenland. They had a meteorological station there which sent weather reports direct to Berlin.

The establishment of a base, the action that resulted in driving out the German meteorologists, and the heroic rescues of the officers and crews of airplanes which had forced landings are all part of the saga of the work of the Air Forces in the bleak island where the most northerly operations of the war are being carried out.

The second part of the book recounts the adventures of the survivors of forced landings of aircraft of the Army Air Forces in Greenland. In addition to giving the details of the hardships endured and the efforts made in effecting their rescue, it shows the important part played by aircraft in the work of these expeditions.

No one will read the story of this expeditionary force without receiving an emotional uplift. The men who volunteered for the most trying work of guarding this important intermediate station should receive the acclaim they deserve. Houghton Mifflin Company, Boston, 1944; 127 pages, $2.00.

Arctic Manual

Vilhjalmur Stefansson

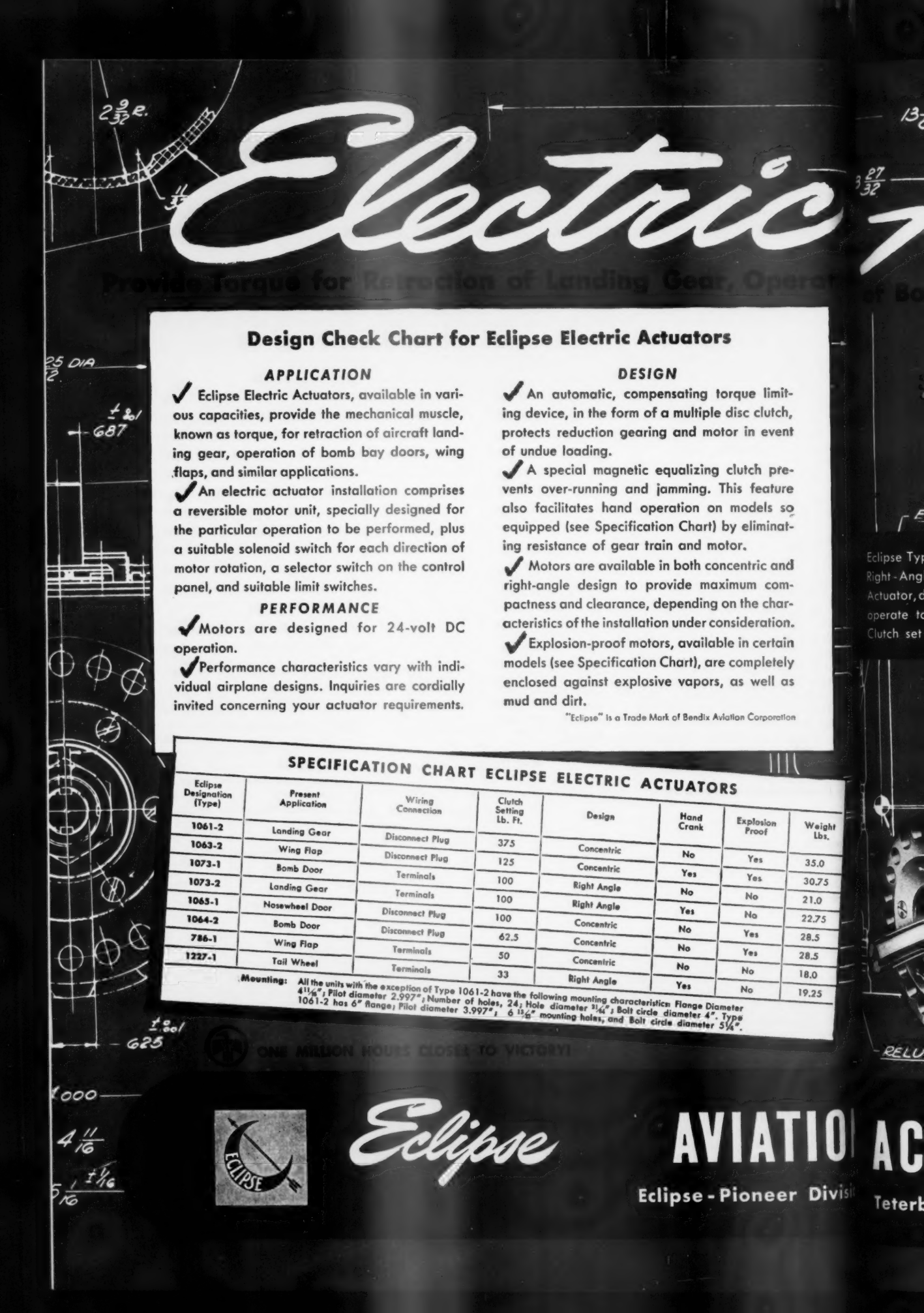
Contents: Historical Background; Physical Geography; Climate and Weather; Light in Polar Regions; Animal Life; Vegetation; Shelter, Heat, and Light; Food and Drink; Clothing and Personal Equipment; Health, Accident, and Disease; Travel; Transportation; Hunting and Fishing; Mechanized Transport.

This book, by one of the best-informed Arctic explorers, was written under the direction of the then Chief of the Air Corps. A condensation of a much larger report that was prepared for the use of pilots who were serving in Arctic and sub-Arctic areas, it was planned to be a manual for the use of flyers and other travellers in the Arctic and Antarctic. It gives directions for living on the ice and on the land, building shelters, procuring food and fuel, wearing protective clothing, and maintaining health.

This book will be surprising to those who regard Alaska and other regions surrounding the North Pole as lands of perpetual snow and ice. It gives in detail the weather conditions that are to be encountered in both winter and summer in northern latitudes. The peculiarities of light in the Polar regions are stressed, since they have a great influence on the life of a pilot.

The chapters about animal life and the use of animals for food and clothing will show that men experienced in Arctic customs can live for long periods without outside aid. Instruction is given in the building of snow houses and the proper placing of tents and shelters. The selection of food and clothing is one of the most important provisions to be made for comfort and health in northern latitudes.

The concluding chapter describes the use of dirigibles and airplanes in the North. Mr. Stefansson has been the advisor of many pilots who fly under the



Design Check Chart for Eclipse Electric Actuators

APPLICATION

✔ Eclipse Electric Actuators, available in various capacities, provide the mechanical muscle, known as torque, for retraction of aircraft landing gear, operation of bomb bay doors, wing flaps, and similar applications.

✔ An electric actuator installation comprises a reversible motor unit, specially designed for the particular operation to be performed, plus a suitable solenoid switch for each direction of motor rotation, a selector switch on the control panel, and suitable limit switches.

PERFORMANCE

✔ Motors are designed for 24-volt DC operation.

✔ Performance characteristics vary with individual airplane designs. Inquiries are cordially invited concerning your actuator requirements.

DESIGN

✔ An automatic, compensating torque limiting device, in the form of a multiple disc clutch, protects reduction gearing and motor in event of undue loading.

✔ A special magnetic equalizing clutch prevents over-running and jamming. This feature also facilitates hand operation on models so equipped (see Specification Chart) by eliminating resistance of gear train and motor.

✔ Motors are available in both concentric and right-angle design to provide maximum compactness and clearance, depending on the characteristics of the installation under consideration.

✔ Explosion-proof motors, available in certain models (see Specification Chart), are completely enclosed against explosive vapors, as well as mud and dirt.

"Eclipse" is a Trade Mark of Bendix Aviation Corporation

SPECIFICATION CHART ECLIPSE ELECTRIC ACTUATORS

Eclipse Designation (Type)	Present Application	Wiring Connection	Clutch Setting Lb. Ft.	Design	Hand Crank	Explosion Proof	Weight Lbs.
1061-2	Landing Gear	Disconnect Plug	375	Concentric	No	Yes	35.0
1063-2	Wing Flap	Disconnect Plug	125	Concentric	Yes	Yes	30.75
1073-1	Bomb Door	Terminals	100	Right Angle	No	No	21.0
1073-2	Landing Gear	Terminals	100	Right Angle	Yes	No	22.75
1065-1	Nosewheel Door	Disconnect Plug	100	Concentric	No	Yes	28.5
1064-2	Bomb Door	Disconnect Plug	62.5	Concentric	No	Yes	28.5
786-1	Wing Flap	Terminals	50	Concentric	No	No	18.0
1227-1	Tail Wheel	Terminals	33	Right Angle	Yes	No	19.25

Mounting: All the units with the exception of Type 1061-2 have the following mounting characteristics: Flange Diameter 4 11/16"; Pilot diameter 2.997"; Number of holes, 24; Hole diameter 21/64"; Bolt circle diameter 4". Type 1061-2 has 6" flange; Pilot diameter 3.997"; 6 13/64" mounting holes, and Bolt circle diameter 5 1/4".

ONE MILLION HOURS CLOSER TO VICTORY!

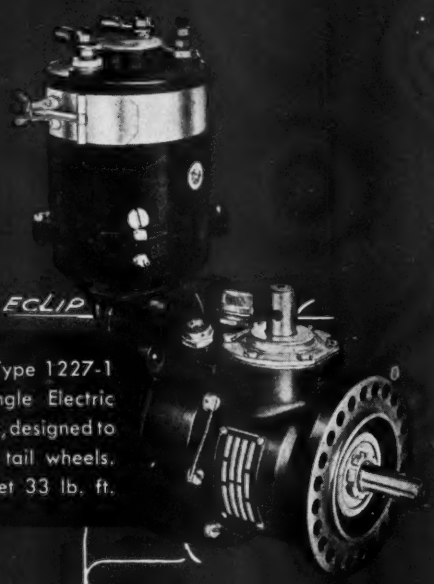
Eclipse

AVIATIO AC

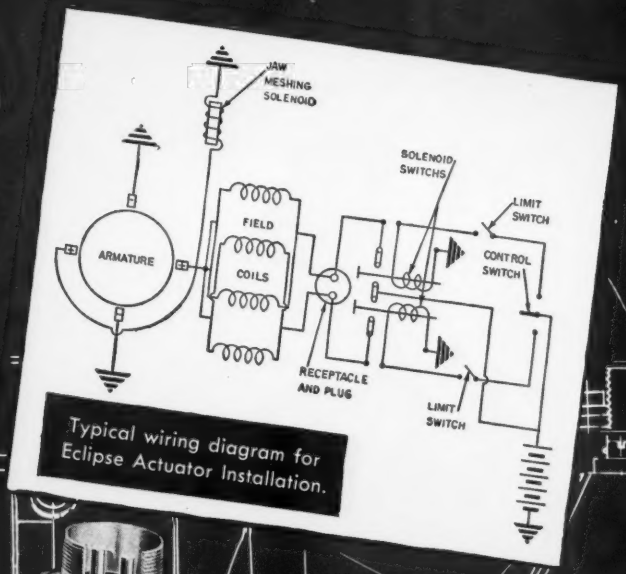
Eclipse - Pioneer Divisi Teterb

Actuators

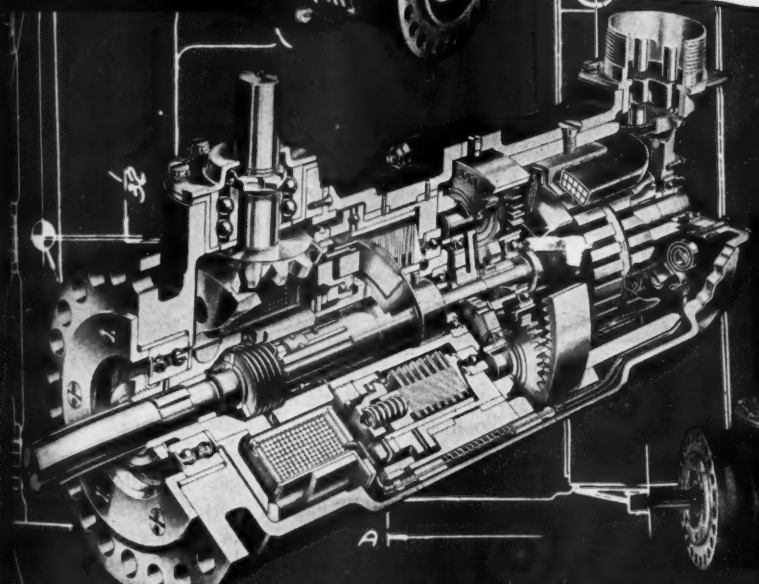
of Bomb Bay Doors, Flaps, and other functions



Eclipse Type 1227-1 Right-Angle Electric Actuator, designed to operate tail wheels. Clutch set 33 lb. ft.



Typical wiring diagram for Eclipse Actuator Installation.



Eclipse Type 1063-2 Concentric Electric Actuator, designed to operate wing flaps. Clutch set 125 lb. ft.

RELUBRICATION CAUTION PLATE

ACCESSORIES

THE INVISIBLE CREW
Precision Equipment by Bendix Aviation Corporation

Teterboro, N. J. — Los Angeles 36, Cal.

They learn about Lockheeds from Lockheed

They are U. S. Army and Navy ground crews, the best-trained aircraft mechanics in any man's air corps.

After three to six months in Army or Navy schools, these men come to Lockheed for intensive one-month postgraduate courses. At our schools—which we operate under Army-Navy supervision at our plants, with company experts as instructors—they learn special tricks for keeping Lockheeds in top flying and fighting shape.

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Today, on every fighting front, Lockheed warplanes are kept in top flying and fighting shape by skilled Lockheed-trained military ground crews. *Tomorrow,* at war's end, civilian Lockheeds—private planes and airliners alike—will be kept at their flying best, too. There will be Lockheed-trained experts to keep your plane in top flying trim wherever you may fly it.

For tomorrow, as today, Lockheed will not only build planes, but get them ready to fly, and keep them ready to fly.

LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION, BURBANK, CALIFORNIA

extraordinarily difficult conditions in the Arctic, and in the book he epitomizes his many years of experience in cooperating with these airmen. It will be an invaluable handbook for the U.S. Army Air Forces serving in Alaska. The Macmillan Company, New York, 1944; 556 pages, $3.00.

Bombers

Keith Ayling

Contents: A Short History of Bombers; Heavy Bomber; The Flying Fortress; The Liberator; British Heavies: Lancaster and Halifax; Stirling, Wellington, and Whitly; American Medium Bombers; British Medium Bombers; The Boston; The Mosquito; Dive Bombers; Torpedo Bombers; Patrol Bombers; Russian Bombers; Axis Bombers; The Future.

This excellent survey of the many types of bombing aircraft used by all countries engaged in the war gives a correct impression of the role bombing is playing in warfare. It is the outstanding instrument of air power and as such deserves the place it has rightfully taken in air strategy.

The author gives informed background historical material about the men and companies who have made the bomber such an important weapon. Too little emphasis is placed on the international effects of the bombing of the former German warships off the Virginia Capes by General Mitchell. This was the real turning point of bombing in world aviation.

The American defensible bombers, the English heavy bomber, the American light bomber, the dive bomber, and the torpedo plane all are reviewed, with descriptions of the many types in service. Interspersed in the historical and technical accounts are many experiences of the famous pilots who have won fame by their bombing exploits. Thomas Y. Crowell Company, New York, 1944; 194 pages, $2.50.

Paratroops

F. O. Miksche

Contents: The Development of the Airborne Idea; Airborne Forces in the Low Countries; The Balkan Campaign and Crete; The Tactical Employment of Airborne Troops; The Landing; The Airborne Division; The Air Move; The Landing Head; The Air Arm with Airborne Troops; Organization of the Defence; The Defence in Action.

This may be considered as a textbook on the training and employment of parachute troops for air warfare. It is a carefully prepared study of the history of the paratrooper and the records of successes he has had in the present war.

The first three chapters deal with the history and the development of the idea of air-borne troops, their utilization in the Spanish Civil War, and their expansion in the present World War. The history part ends with the Battle of Crete, since the author did not attempt to follow the rapidly moving air-borne events in Russia and the Far East. In Chapter 4 and the following chapters he discusses in considerable detail questions relating to the tactics of air-borne troops and various air-borne maneuvers.

Of the greatest interest is the carefully prepared description of the organization of air-borne formations and their use in attacks from positions at the rear of an enemy. In the 7 years since the Soviet Army first demonstrated the use of the paratroopers, every other army has developed this new service to a degree that may revolutionize tactics. As Liddell Hart says in a preface, the author "is exploring what is by comparison almost virgin country." Faber and Faber Limited, London, 1943; 173 pages, 10*s*. 6*d*.

Rockets: The Future of Travel Beyond the Stratosphere

Willy Ley

Contents: The Beginnings of an Idea; The Decades of the Great Dreams; "The Rocket's Red Glare, . . ."; Prophets with Some Honor; The Battle of the Formulae; Success, Failure, and Politics; The Meteorological Rocket; The Rocket into Cosmic Space; The Spaceship; Terminal in Space.

This study of the history and development of rocket propulsion should not be confused with the development of the jet-propulsion engine which has been creating so much interest recently. The rocket power plant is a self-contained unit and is not dependent on a supply of oxygen from the air, while any jet-propelled airplane depends at present on the presence of air, limiting the altitudes to which it may operate.

The author has been intimately connected with the work of rocket development for twenty years. He is familiar with the history as well as the scientific study of the rocket, and in this book gives the reader the background as well as the present state of the art. The rocket has so often been used by fanciful writers and imaginative inventors that it has been regarded by the public as associated with interplanetary travel and therefore remote. Space ships, week-end trips to the moon, and phenomenal speeds are in the rocket field.

Mr. Ley writes rationally as a proponent. He does not hesitate to look facts in the face and to let science and mathematics reduce many plans to the realm of improbability. He does not, as so many other writers have done, completely overlook the use of the rocket in this country by the military, and the interest by those who were courageous enough to form the American Rocket Society, and particularly the work of Dr. Goddard. As no field of aviation should remain unexplored, even though this one has had many setbacks, Willy Ley's book may have the effect of arousing greater interest in rockets for air travel, as well as for use as a weapon such as the bazooka. The Viking Press, New York, 1944; 287 pages, $3.50.

Long-Range Flight

Colin Hugh McIntosh

Contents: Toward a Better Technique; Engine Performance; Aircraft Performance; Operating Techniques for Cruise Control; The Planned Flight; Temperature as a Factor in Fuel Measurement.

A text for training pilots and navigators in the essential techniques of aircraft operation. The author, who is Chief Navigator of American Airlines, explains the fundamentals that must be understood in order to make use of the charts customarily employed by the air-line operators. Included in the text are the principles of efficient engine operation, the principles and use of airplane cruising charts, methods of cruising control, preflight planning, and controlled flight through use of the "howgozit" chart.

The explanations have been made as simple and nontechnical as possible, the engineering approach having been avoided. Although performance data in this text have been limited, for reasons of military security, to the DC-3 type airplane, the principles explained are applicable to all types of modern aircraft. McGraw-Hill Book Company, Inc., New York, 1944; 177 pages, $2.50.

Elementary Aircraft Structures

Millard V. Barton

Contents: Design Requirements; Aircraft Loads; Load Transmission in the Aircraft Structure; Correlation of Load-Carrying Ability and Properties of Materials; Design of Tension, Compression and Shear Members; Riveted and Bolted Connections; Bending; Stresses in Beams; Torsion; Design of Columns and Struts; Buckling of Flat Sheet; General Design Considerations.

Fundamental concepts and principles of mechanics and their application to aircraft structural elements are presented in the form of a collection of notes. The analytical portion of the book begins with a considerat on of aircraft loads, this subject being treated as a connecting link between aerodynamics and structural design. The notes end with practical considerations necessary for all good designs. The material is presented without the use of calculus, but the equivalent expressions in the calculus notation are given in footnotes following the development. The notes are intended to provide the designer with sufficient knowledge of stress analysis to make estimates of the size of aircraft structural elements, to obtain preliminary strength checks of design, and to appreciate practical considerations affecting the final design. Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 77 pages, $1.50.

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liquid resin glue

used with catalyst FM-60

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The extraordinary progress made in the production of large gliders is one of the most interesting accomplishments of aircraft designers. The use of gliders for carrying troops, supplies, and armament will probably be an important factor in the future operations of the war. This book is a clear description of the three branches of the air-borne services. It gives the present status of this branch of the Army and the possible uses of gliders in postwar commercial air transport. D. Appleton-Century Company, Inc., New York, 1944; 192 pages, $2.50.

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Earl Church

Contents: Fundamental Principles of Aerial Photogrammetry; Applications of the Fundamental Principles to Practical Problems in Photogrammetry; Stereocomparagraph and Contour Finder Technique; Planimetric Map Compilation Based upon Radial Line Plotting; Mosaics; Topographic Mapping with the Multiplex Projector; Perspective Grid Method for Constructing Planimetric Maps from High Oblique Photographs; Tri-Metrogon Method for Reconnaissance Mapping.

Basic material for a first semester's course in aerial photogrammetry is contained in this textbook. In the first part the particular fundamental principles that constitute a sound theoretical background in photogrammetry are presented. The second part considers the practical mapping methods essential to an initial working knowledge of the subject. Syracuse University Press, Syracuse, N.Y., 1944; 95 pages, $2.75.

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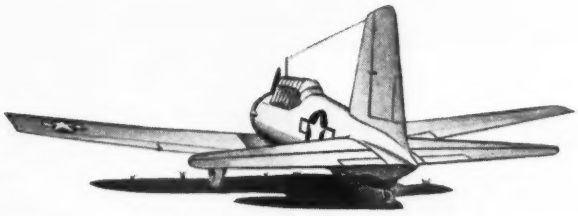

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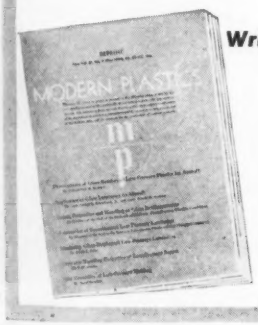

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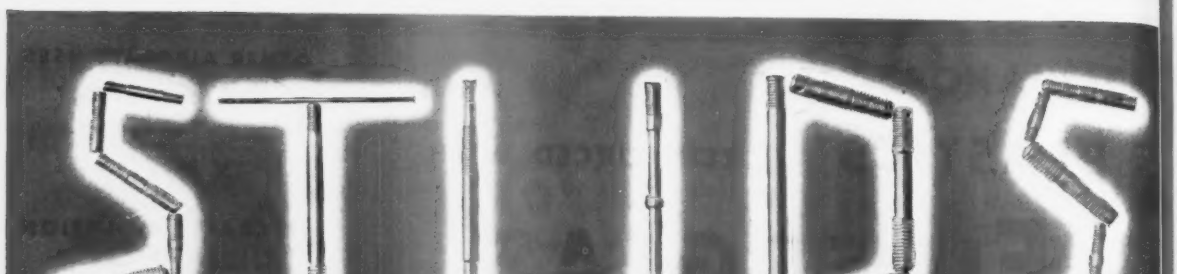

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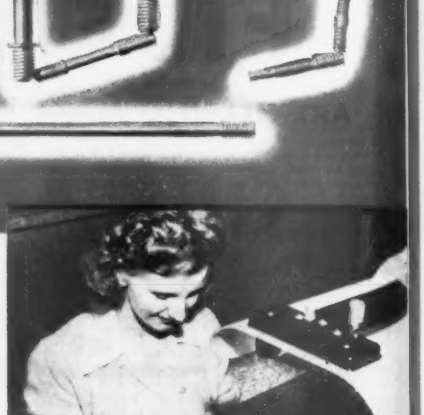

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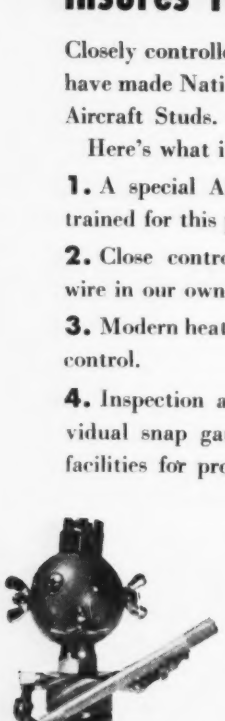

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Contents: Modern Aircraft; Modern Aircraft Engines; Aircraft Statistics; Buyer's Guide.

This yearbook grows in its essentiality with each succeeding edition. It is one of the indispensable reference books about the progress of world aviation. Its main sections are divided into descriptions of modern aircraft of practically all countries that have aircraft factories; modern aircraft engines; and aircraft statistics that include a wealth of information regarding aeronautical organizations.

The aircraft and engine sections are classified according to countries and each section has an index. Brief descriptions and photographs of aircraft used by the U.S. Army Air Forces are grouped in pages preceding the detailed data pages showing all American types. With certain exceptions, airplanes previously originating in Axis-dominated countries are omitted. The statistical section gives information about aircraft performance records, Government departments concerned with aviation, associations and scientific societies, and statistics of domestic air-carrier operations.

Several officers of the Army and Navy contribute short accounts of their special work. There is also a section devoted to the work of the Wright Brothers. Unfortunately, some of this material is inaccurate and will give a wrong impression of this epoch-making event.

The expansion of such annuals is a healthy sign of the growing extent of aircraft development and no one can study the pages without becoming impressed with the engineering progress in aircraft design and construction. It is a book that must be available for reference for any one who wishes to keep abreast of the fast-moving aeronautical industry. Aerosphere, Inc., New York, 1944; 1 volume, $15.

Composite Aircraft Manufacture and Inspection

Lt. (j.g.) Leno C. Michelon

Contents: Part I—Aircraft Materials: Metals in Aircraft, Wood in Aircraft, Plastics in Aircraft, Fabrics in Aircraft; Part II—Aircraft Processes: (Heat Treatment of Aluminum and Steel; Plating and Finishes); Aircraft Production Processes; Part III—Aircraft Inspection Methods: Dimensional Control; Testing for Physical Properties; Aircraft Inspection Procedures.

A practical encyclopedia of composite aircraft manufacturing and inspection. The book is intended as a reference manual for those concerned with either of these aspects of manufacture, as well as for trainees in the airplane inspection field. It includes information about the basic materials used in manufacturing aircraft and gives in detail the Army-Navy Aeronautical Specifications for each. The inspection instruments and methods used to insure adequate performance and maximum safety are explained.

Appendixes include aircraft nomenclature; an index of Army-Navy Aeronautical Specifications; and tables of standards of hardness, tolerances, allowances, etc. Harper & Brothers, New York, 1944; 547 pages, $6.00.

Angular Spacing Tables

Computed and compiled by Werner F. Vogel

The publishers, manufacturers of optical inspection machines, felt a need for numerical tables giving angular spacings for use in connection with the designing of instruments, particularly in the spacing of teeth in precision gears, splines, index plates, etc. Finding none that met all the requirements of convenience and accuracy, they computed and compiled sets of such tables for their own use. Subsequent demand on the part of others has resulted in the publication of this compilation in its present form.

It is customary in extremely accurate work to compute the angular spacing in precision gears, splines, index plates, etc., in angular measurements by degrees, minutes, seconds, and decimals of the second. These tables give such calculations—replacing the slow, cumbersome, and possibly erroneous methods of making such computations individually.

This volume contains figures for measuring the included angle between any point of beginning and any one or more divisions of a circle up to and including 200 divisions. The method of using the tables is as follows: The Index column on each half-page corresponds to the number of teeth; the reading in degrees, minutes, and seconds with decimals is found in a horizontal line opposite each index.

An appendix has been added to show the values of the fundamental dividing angles and other important constants tabulated with a hitherto unpublished number of digits. A new type of conversion table, converting minutes and seconds in one reading to decimals of the degree, has been included; in another table a single reading converts an optional sequence of decimals, hundredths, and thousandths of the second to decimals of the degree.

The book is ring-bound and the pages are made of a special washable-coated material. The color is light green to reduce eye strain; the figures are of large and easily readable size and are set off by white lines, making it easy for the eye to follow a straight line across the columns. Vinco Corporation, Detroit, 1943; 233 pages, $10.00.

Book Notes

Miracles Ahead! by Norman V. Carlisle and Frank B. Latham; The Macmillan Company, New York, 1944; 288 pages, $2.75.

Anyone who attempts to assemble in one book the predictions of what specialists in many fields believe the postwar world will be like is certain to be accused of being too optimistic. Evidently the authors of this book have not hesitated to accept the most radical claims and make them seem practical. This is especially evident when the automobile and the airplane of the future are described. It is seldom that changes are made except by an evolutionary process. The jump from the conventional to the completely novel does not come usually so quickly as expected.

The chapter on the "Flying Flivver" indicates that the reader's first plane will be a helicopter and that a flying automobile is just around the corner. In a chapter on "Global Transportation" the drawing-board versions of airplanes carrying a hundred or more passengers seem to be almost immediately realizable. All of the other possibilities, some of which are not new (for example, seadromes, stratoliners, glider freight trains, rocket and jet propulsion), are outlined.

As a book to challenge the imagination of the reader and to stimulate his belief in a better and more comfortable world, it will serve a useful purpose.

Combat Report: The Story of a Fighter Pilot, by Hector Bolitho; B. T. Batsford Ltd., London, 1943; 138 pages, 8*s.* 6*d.*

An Englishman who had found sheep raising in Australia unpleasant returns to England and joins the R.A.F. This book follows his career through its training period and as a pilot and commander of a squadron. It is a detailed account of the life of a pilot in the R.A.F. who brought down thirteen enemy aircraft.

Teacher of Business: The Publishing Philosophy of James H. McGraw, edited by G. D. Crain, Jr.; Advertising Publications, Inc., Chicago, 1944; 91 pages, $1.00.

Although this book has little to do directly with aviation, it does present generalities that apply to the aeronautical profession as well as to the other engineering groups. The emergence of what may be called professional consciousness came in the 1880's and has taken 60 years to reach its present great influence. The business and the trade papers, as well as the society journals, have all had their parts in the development of these professional standards.

James McGraw was not only a pioneer in the work, but his ideals of publishing led the way to higher editorial standards such as are exemplified in one of the McGraw-Hill publications, the magazine *Aviation.*

The Conquest of North Africa, 1940–1943, by Alexander G. Clifford; Little, Brown and Company, Boston, 1943; 450 pages, $3.00.

Although the battles of North Africa were primarily land operations, the R.A.F. was developing a new form of cooperation with ground forces. The team of Tedder and Coningham was experimenting in the tactical use of the R.A.F.; this was to give Tedder the reputation as a leader which has placed him in command of all air forces of the great invasion.

The difficulties under which operations were conducted were severe. The English air strength was one-third that of the Germans. All aircraft engines ground themselves to uselessness within a few hours because of the gritty desert sand. The German Messerschmitt 109F was found to be as good as, or better than, the British fighter planes available, and there was no evidence that the Germans were short of fuel. But it was here that Tedder is reported to have made a statement that should be remembered. He recognized that mutual good will was the first essential of real cooperation and he described the idea as "a happy marriage in which neither partner is dominant." Air superiority was attained through the leadership and personal qualities of the British pilots.

From then on the R.A.F. used revolutionary tactics. Airplanes were forbidden to fly at more than 6,000 ft. Dogfights with enemy fighters were to be strictly avoided. The air force was to be subordinated without reserve to the requirements of the army. Everyone had to be doing a positive job all the time. At times sorties were made every 20 min.

The R.A.F. carried its weight in the chase of Rommel but, even more important, it gave Tedder the experience to demonstrate his outstanding qualities as an air tactician.

Into the Jaws of Death, by Michael Stern; Robert M. McBride & Company, New York, 1944; 237 pages, $2.75.

By giving stories of fighting men related in their own words, the author has produced one of the most interesting of the recent war books. Capt. James Verinis, co-pilot; Capt. Charles Leighton, navigator; Capt. Vincent B. Evans, bombardier; and Staff Sgt. John P. Quinlan, tail gunner, tell the story of one of the bombing sorties of the famous Flying Fortress, "The Memphis Belle." Major Levi R. Chase, then the leading American ace in the North African battle zone, describes his take-off in a P-40 from a carrier's catapult to attack Port Lyautey and his flight of 600 miles to an airport in Algiers to join the attack on the Italian Air Force and the German Luftwaffe in Tunisia.

What is possibly the most interesting chapter tells of Major Gerald Crosson's experiences in the South Pacific fighting Japanese Zeros and bombing enemy transports. He was the chief pilot of the New York Police Department and was nicknamed the "Flying Cop." Lt. Eugene Wasserman gives a participant's account of the tactical bombing of first-line German troops in Tunisia.

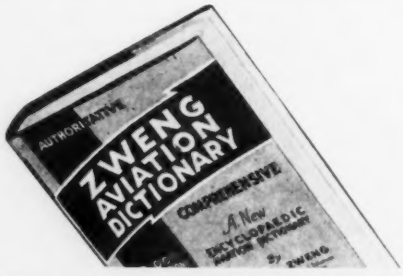
Other chapters of the book describe the work of the Patrol Torpedo Boat squadrons, the torpedoing of a transport, the attack and near destruction of the heavy cruiser "San Francisco"; the attack on Salerno, and the bloodiest engagement in the history of the Marines on the coral reefs of Tarawa.

Now We Fly, by Frank E. Sorenson and George E. Rotter; The John C. Winston Company, Philadelphia, 1944; 184 pages, $1.50.

Boys need a book of instruction written in conversational style to introduce them to the art of flying and its dependent services. This book tells just what a youth wants to know about the machine he hopes to use when he is older. It is another useful book in the group for the student in school, and will stimulate his interest in aviation.

The Warm Front, prepared by Training Division, Bureau of Aeronautics, U.S. Navy; Aerology Series, No. 5; 32 pages, $0.10.

This is the fifth of a series of booklets on aerological subjects, written for aviation cadets. It explains how warm fronts are formed, how they can be recognized, what conditions are found in the areas surrounding them, and how to fly them.



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Atlas of Global Geography, by Erwin Raisz; Global Press Corporation, Publishers, New York, Harper & Brothers, Distributors, New York, 1944; 64 pages, $3.50.

The airplane has made it necessary for anyone to relearn geography who wishes to understand the possibilities of the so-called air age into which we are entering. The Mercator cylindrical map is not only no longer useful; it is definitely harmful to a correct understanding of the relationships between different places on the earth. The author has prepared this book with this new point of view. All the maps are global or on spheres instead of distorted on flat surfaces.

No attempt is made to include large numbers of names of small places, as in a gazetteer type of atlas. It is rather intended to acquaint the student with the surface of the earth as it should be known. This does not mean only the location of countries and cities, but also the climate, topography, vegetation, oceanic areas, and the industrial and agricultural possibilities, as well as the problems of language, race, and religion. All these will have to be better understood when the earth shrinks so that no point on its surface is over 60 hours' flying distance from any other locality. There will be a greater need for understanding the sociological aspects of geography than formerly, for the intermingling of people will be more frequent with the development of world air transport.

Undoubtedly the book is a forerunner of the textbooks on geography as it will be studied in the future. No one who reads it will disagree that it is a much more interesting way to present the subject.

Bombers Across, by Capt. Edgar J. Wynn; E. P. Dutton & Co., Inc., New York, 1944; 178 pages, $2.50.

The ferry pilots of the Army Air Forces do not get the assignments for missions which make thrilling stories of attacks on the enemy, but their work is just as important. The author, who made 44 crossings of the Atlantic by air, makes the interesting observation that the air-line pilot is unexcelled in his specialized flying, the Navy pilot is certain that he is the best-trained pilot in the world, and the pilots of the Army Air Forces believe that they are superior. The latter two have a certain contempt for the civilian pilot, while the air-line pilot looks down on everyone else. The author believes them all to be wrong. He feels that the old-timer who barnstormed and had some Army and Navy training makes the most reliable pilot for ferrying airplanes to all parts of the world.

The work of the transatlantic ferry pilots who were based at Prestwick, Scotland, and the effects of several tragic accidents make interesting reading and show the many dangers encountered by the pilots who bucked the North Atlantic weather.

Captain Wynn left the North Atlantic route and joined Pan American to fly the South Atlantic, across Africa, and on to Iraq. Tiring of this life, he became a pilot for T.W.A. in its North Atlantic ferrying operations.

The author asserts that the pilots of the Air Transport Command have greater experience and knowledge than that of the combat pilot. Although he does not claim to tell the story of the A.T.C., he believes that it will become one of the great tales of the war, deserving full narration.

Volcano Island, by J. M. Spaight; Geoffrey Bles, London, 1943; 152 pages, 7*s.* 6*d.*

The author, who is one of the best informed British authorities on air warfare, traces the eruption of air power from England from its small beginnings in 1940 to the present volcanic bombing of Germany.

The criticism that the Royal Air Force had to meet from government officials and others held back all-out strategic bombing for many months. A strong defense was the principal aim, but it was soon demonstrated that the war production of the enemy would have to be curtailed if a successful invasion were to be made possible.

The defenses of Germany in practically every area were strong and it is stated that 1,500,000 German soldiers and civilians were engaged in defense against the British air offensive. German camouflage, which concealed vital centers, was also used to divert bombers from their objectives by simulated fires and even imitation villages. The overstatement of the effects of the early bombings is criticized as leading to a reaction unfavorable to air power.

The bombing by the R.A.F. in 1940 kept alive and vigorous what was then called a "phoney war" because of inactivity of the armies. The great losses of bombing by daylight forced the R.A.F. to its night-bombing offensive. The author explains at length why this change was necessary.

The book gives a studied account of the bombing by the R.A.F. and later by the A.A.F., showing how it gradually wore down the strength of the Luftwaffe, disrupted ground communication, and affected the aircraft and armament productivity of Germany. It gives excellent descriptions of the many English and American bombing airplanes. The prediction is made that the effects of the great bombing program will be comparable to the overflowing of a volcano, bringing destruction in the path of its released forces.

Love Letter from an Impossible Land, by Lt. (j.g.) William Meredith; Yale University Press, New Haven, Conn., 1944; 52 pages, $2.00.

Only about ten of the poems in this book have an aviation motive. However, as Archibald MacLeish writes in a foreword, "They are not only poems written by a Navy flyer about air war in an 'impossible land': they are poems written from within that experience. They have an accent, a tone, of participation."

Victory from the Air, by Auspex; Geoffrey Bles, London, 1941; 238 pages, 10*s.* 6*d.*

Although this book was written in 1941, it is of interest now because it gives an excellent account of the events leading up to the unfortunate position in which England and France found themselves in aerial preparedness at the outbreak of the present war.

The author reviews the potentialities of air power and outlines its position as the dominant factor in winning the war. He describes the various types of aircraft and armament that have proved their usefulness in the air war, and includes brief descriptions of American aircraft and engine builders, their plants, and the products they furnish for the United Nations.

The flying technique of the Germans and Italians is analyzed and its shortcomings are shown. The reasons for the separation of the Naval Air Arm from the Royal Air Force are given. The successes of the pilots of the Royal Navy are emphasized.

This is one of those background books that are helpful in forming impressions of the new use of air power.

Our Air-Age World, by Leonard O. Packard, Bruce Overton, and Ben D. Wood; The Macmillan Company, New York, 1944; 838 pages, $2.80.

This book, a geography that has been indoctrinated by aviation, attempts to interpret for the student what the airplane has done to the old conceptions of time and distance. Global geography is no longer confined to the surface of the earth but extends to the air above and its eccentricities. Each continent is studied in its new relationship to world affairs, and the world as it may be tomorrow is envisioned.

The youth of the country must be prepared for active participation in the new world. They must be acquainted with the changes as they are taking place. The authors have tried to show what forces are now operating to bring about a new world in which the United States will play a dominant part.

Ernie Pyle in England, by Ernie Pyle; Robert M. McBride & Company, New York, 1944; 228 pages, $1.49.

This famous correspondent, who specializes in the human side of the war at the front, devotes some space in this interesting book on wartime England to the effects of bombing. He gives instances of some of the unusual effects of bombs. Two policemen were inspecting a delayed-fuse bomb when it exploded. No traces were ever found of one but the other only had the buttons blown off his coat and was not hurt. The suction from a bomb explosion is almost as great as the blast away from it. One house may be blown inward while, on the opposite side of the street, the front of a house may be sucked out. He credits the story of a rug being pulled off a floor from underneath two tables and a piano, leaving them standing as they were. The book makes interesting reading.

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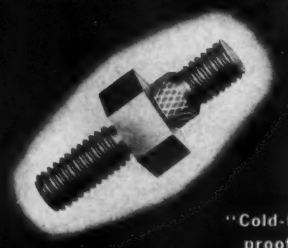

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Navy Shipboard Administration, edited by Capt. Harley F. Cope; W. W. Norton & Company, Inc., New York, 1944; 281 pages, $2.75.

This guide for naval officers gives the duties and responsibilities of the more important officers on warships. Of especial interest is the description of the organization of an aircraft carrier and the operating personnel.

Each chapter is written by a specialist in his department; this gives the book an authority that will be recognized by the completeness of the text.

Show Window of Life, by Elizabeth Hiatt Gregory; Wayside Press, Inc., Los Angeles, 1944, 160 pages, $2.00.

There are few writers who were privileged to follow the beginnings of American aviation. Miss Gregory witnessed the early flights of Wilbur Wright and Glenn Curtiss in and near New York. She saw the attempts of the Aeronautical Society to hold meets in the early years of the century and reported the famous Belmont International Meet in 1910. In a chapter of her autobiography she relates how she became a pioneer woman writer on aviation. She gives her impressions of those early days and of the pilots who were then making aeronautical history.

The Naval Officer's Guide, by Comdr. Arthur A. Ageton; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1944; 587 pages, $3.00.

The second edition of this informative naval reference book gives the essential information regarding the organization, administration, and operation of our Navy. It explains the training program, gives data on uniforms, and outlines the duties and responsibilities of various heads of the departments of a ship. The book may be regarded as a compendium of facts with which every naval officer should be conversant.

Triumph of Treason, by Pierre Cot; Ziff-Davis Publishing Company, Chicago, 1944; 433 pages, $3.50.

The deplorable political and economic condition of France for several years before its surrender is evident from this violent defense of a former Air Minister who was under the attack before the Supreme Court at Riom when other heads of the former French government were tried.

The parts concerning the direction of the Air Ministry by the Popular Front ministry headed by Premier Blum are astonishing in their admissions. Composed of Communists and radicals, the Ministry nationalized the aircraft industry and sought close collaboration with the Soviet Union. Its members supported the Republican Government in Spain and furnished it many airplanes.

The figures representing France's strength and production do not check with what was generally conceded to be the status before the war. However, they are interesting as showing how inferior, even with exaggerated figures, the French Air Force was at the beginning of the war.

Although France had an independent Air Ministry, M. Cot shows how it was dominated by the Army General Staff, which seemed to have only a 1918 conception of air power. The book is an interesting partisan document and will afford much new information about the political intrigues that were directly responsible for the weakness of France in time of war.

Limit of Darkness, by Howard Hunt; Random House, New York, 1944; 227 pages, $2.50.

The pilots who lived at Henderson Field on Guadalcanal probably suffered more hardships and discomforts than those at any other place. This book confines its story to a 24-hour period into which is crowded experiences that usually extend over many days. The officers are fictitious but they seem to be of the type that was engaged in the dangerous operations against the Japs.

Because of the fictional character of the story it is more interesting than a factual account of the life in this sweating jungle station. It gives a close-up of experiences in the Southern Pacific as no other book has done.

Turret Lathes, by Emanuele Stieri; Essential Books, distributed by Duell, Sloan and Pearce, New York, 1944; 211 pages, $1.50.

The basic principles involved in the operation of turret lathes are explained in this manual. Detailed descriptions are given of standard turret lathes used in production plants. The necessary tool setups for specific jobs are described and illustrated. Cutting tools and methods used for sharpening them are discussed. One section contains an explanation of micrometers, verniers, and measuring tools.

Principles of Powder Metallurgy, by Franz Skaupy; Philosophical Library, New York, 1944; 80 pages, $3.00.

A translation of a German book about powder metallurgy, to which the author applies the name of "metal ceramics." Subjects discussed include the production of metal powders and their properties and the production of "ceramic-metal" parts. A special section of the book is devoted to the "ceramics" of wolfram, molybdenum, tantalum, and other metals, as well as to the "ceramics" of hard metals. An appendix contains comments about further fields for application of the process.

Graphical Solutions, by Charles O. Mackey; John Wiley & Sons, Inc., New York, 1944; 152 pages, $2.50.

This is the second edition of a textbook on the construction and application of curves, diagrams, and charts for the graphical and mechanical solution of engineering problems. In this edition the discussion of the construction of alignment charts has been expanded, and the subject of projective transformation is taken up. There are new illustrative examples and exercises; a complete explanation is given of the use of determinants in the graphical representation equations of special form that contain as many as six variables. A new chapter, which explains the fitting of empirical equations to periodic curves, has been included.

The Model Plane Annual, 1944, by David C. Cooke; Robert M. McBride & Company, New York, 1944; 224 pages, $2.75.

The third edition of an annually published handbook for model builders. In this issue particular attention is given to information about the way to build model airplanes. One chapter reviews the conquest of the air and another is devoted to engine theory and the construction of model engines. The official A.M.A. rules are listed, and there is a glossary of aeronautical terms.

Drill Presses, by Emanuele Stieri; Essential Books, distributed by Duell, Sloan and Pearce, New York, 1944; 216 pages, $1.50.

The fundamental principles involved in the design and operation of drill presses are explained in a manual. Various types of sensitive multiple-spindle and radial-type drill presses used in modern production plants are described. Sections discuss the selection of proper drills for specific drilling jobs and the proper methods of grinding drills. Information is given about the correct speeds and feeds for drilling various kinds of metals, plastics, and other materials. Data tables are included and several specific jobs are described.

Your World Tomorrow, by Donald G. Cooley and editors of *Mechanix Illustrated;* Essential Books, distributed by Duell, Sloan and Pearce, New York, 1944; 252 pages, $2.50.

How new scientific developments will change postwar ways of living, traveling, working, and playing are predicted in this book. Two of the thirteen chapters refer to air travel: One is devoted to a forecast of the helicopter's uses; the other to general changes in transportation methods, with the trend toward the airplane.

How to Pass Radio License Examinations, by Charles E. Drew; John Wiley & Sons, Inc., New York, 1944; 320 pages, $3.00.

Second and revised edition of a preparatory syllabus for commercial radio-operator license examinations. For the purpose of helping the student to answer actual examination questions, subject matter has been added in the form of discussions and explanations of some 1,300 questions contained in the Study Guide issued by the Federal Communications Commission. This edition also supplies data on modulation, oscillators, classes of amplifiers, rectifier power supplies, and the operation of circuits to provide maximum frequency stability of a transmitter. Problems dealing with percentage modulation and questions on typical troubles and causes of distortion of an audio signal are discussed.

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Japan: Its Resources and Industries, by Clayton D. Carus and Charles Longstreth McNichols; Harper & Brothers, New York, 1944; 252 pages, $3.50.

As a basis for evaluating Japan's importance in the postwar world, a study of her resources is offered. The compiled information is pertinent to the geographic, agricultural, animal, mineral, commercial, industrial, manufacturing, and human resources.

Modern Wood Adhesives, by Thomas D. Perry; Pitman Publishing Corporation, New York, 1944; 208 pages, $3.00.

In this book information is given about the major wood adhesives and their relative qualities. Chapters are included which indicate a new and direct approach to the fundamentals of heat and pressure as applied to gluing technique. Other chapters deal with gluing equipment, impregnated products, and testing methods. Special attention is given to the synthetic-resin adhesives.

World Wide Planisphere for Finding and Identifying Navigation Stars and Constellations from All Latitudes . . North or South Throughout the Year, by William H. Barton, Jr.; Addison-Wesley Press, Inc., Cambridge, Mass., 1943; 1 volume, $1.00.

A combination planisphere in the form of four disc charts for finding and identifying navigation stars and constellations from all latitudes, North or South, throughout the year. For orientation and navigation purposes, two star discs are used. These bear the names of the 55 navigational stars listed in the American Nautical Almanac and the Air Almanac, and a list of these stars is given with their positions and magnitudes. One of the charts is for use in the Northern Hemisphere; the other, for the Southern.

Two similar discs are provided for the amateur astronomer learning the constellations. They contain the names of the constellations and the principal Greek letters, together with full instructions for the adjustment of the discs. Four masks are provided, one each for 20°, 40°, 60°, and 80° latitudes. A mask may be folded over any one of the four star discs. By comparing two masks 20° different in latitude, the user may readily estimate where the horizon would be for intermediate latitudes.

The Engine Lathe, by Emanuele Stieri; Essential Books, distributed by Duell, Sloan and Pearce, New York, 1944; 308 pages, $1.50.

The basic principles of the engine lathe are explained in a pocket-size book. The various parts of this extensively used machine tool are described in simple language with the aid of diagrammatic drawings. Subjects discussed include cutting tools and methods of sharpening them; micrometers, verniers, and other measuring tools; and screw cutting. Actual lathe setups are used as examples. Tables of data for mechanics are given in an appendix.

Mathematics for Exterior Ballistics, by Gilbert Ames Bliss; John Wiley and Sons, Inc., New York, 1944; 128 pages, $2.00.

A study of the elementary calculus and differential equations used in the theory and computation of the trajectories, with their differential corrections listed in range tables for artillery fire control. The book is divided into seven parts: The first chapter treats of the need for mathematics in exterior ballistics; the second, of the differential equations for a trajectory; and the third, of the Siacci theory. Chapter IV discusses the approximate integration of the equations of exterior ballistics; Chapter V, differential corrections; and Chapter VI, bombing from airplanes. The final section contains tables for computation.

Tables of Lagrangian Interpolation Coefficients, prepared by the Mathematical Tables Project of the Work Projects Administration of the Federal Works Agency, conducted under the sponsorship of the National Bureau of Standards; Columbia University Press, New York, 1944; 394 pages, $5.00.

This is one of a group of volumes included in the Mathematical Tables Project operated by the Work Projects Administration under the sponsorship of the National Bureau of Standards. When the W.P.A. was discontinued, the sponsoring agency took over this part of the work with the support of other government agencies, resulting in the completion of this book and several others. It contains tables based on the Lagrange interpolation formula for use in connection with the theory of polynomial interpretation. This volume extends the few existing tables of Lagrangian interpolation coefficients in certain polynomials by giving entries at smaller intervals of the argument and by making adequate provisions for interpolation near the beginning and the end of a table. All of the coefficients of Everett's central difference formula involving differences up to the eighth order can be found in this volume. Coefficients of the Gregory-Newton and Newton-Gauss formulas also are included. The precise relationships that the Lagrangian coefficients bear to those involved in the difference formulas mentioned are given in a section of the explanatory text. Other sections of the text matter refer to the properties of the Lagrangian interpolants, the analysis of error in interpolation, illustrative examples, and numerical integration.

Basic Problems in Celestial Navigation, by William H. Barton, Jr., and Charles O. Roth, Jr.; Addison-Wesley Press, Inc., Cambridge, Mass., 1944; 56 pages, $1.00.

A selected sequence of problems in celestial navigation prepared to develop understanding and skill in the many routine procedures encountered in present-day methods of navigation. The sections, each of which treats one type of problem or an essential part of a problem, are illustrated by examples. Answers to the problems are given in the last section of the book. This volume supplements two earlier books by William H. Barton, Jr., *An Introduction to Celestial Navigation* and *Stereopix.*

Military Applications of Mathematics, by Paul P. Hanson; McGraw-Hill Book Company, Inc., New York, 1944; 447 pages, $3.00.

The purpose of this book is to provide direct training in the practical mathematical work of the various branches of the armed services. It is intended to bring together in a single volume the problems in all branches of the armed forces which can be solved with a background of high-school mathematics. The problems are grouped according to Army and Navy classifications. Although the book avoids material above the secondary-school level, it does not omit anything of importance to the average combat officer or enlisted man. A chapter about the mathematics of air navigation gives fundamental instruction and exercises in dead reckoning, terrestrial navigation, and celestial navigation. An appendix contains a mathematics refresher course and background mathematical material.

Plastic Working of Metals and Non-Metallic Materials in Presses, by E. V. Crane; John Wiley & Sons, Inc., New York, 1944; 540 pages, $5.00.

In this third edition of a text on press-working methods of fabricating engineering materials there are three new chapters, together with additions throughout the book and in the appendix. One of the new chapters discusses the use of semipermanent die materials in more flexible presses for limited-lot production. The second investigates the behavior of the many types of materials in the several states of plasticity, correlating the data now available with that presented in earlier chapters. The third considers the application of plastic-flow methods to the molding of nonmetallic, as well as metallic, powders and to the forming of sheet plastics and composite laminates.

American Air Mail Catalogue, 1941 Supplement, American Air Mail Society; The Airpost Journal, Albion, Pa., 1941; 127 pages, $1.00.

Intended for noncurrent use with the 1940 edition of the air-mail stamp catalogue, the supplement contains corrections or additions to the material in the original. Additional listings refer to events that occurred after the initial publication of the catalogue.

The Analysis of Engineering Structures, by A. J. S. Pippard and J. F. Baker; Edward Arnold and Company, London, 1936; 554 pages, 30*s.*

A general outline of the theories upon which the design of structures is based. While excluding problems of practical design, this textbook includes methods of analysis which are not usually given in treatments of the subject.

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The Slotted-Templet Method for Controlling Maps Made from Aerial Photographs, by Harry T. Kelsh; U.S. Department of Agriculture, Miscellaneous Publication No. 404, U.S. Government Printing Office, Washington, D.C., 1940; 38 pages, $0.15.

A booklet describing and explaining the slotted-template system of obtaining horizontal control in the construction of planimetric maps from aerial photographs. This method is also compared with the hand-template system, and the results of tests with slotted template are reported.

Unit Course in Aircraft Sheet Metal, prepared for the Air Service Command, U.S. Army Air Corps, in cooperation with the U.S. Office of Education, by the Utah State Board for Vocational Education; Salt Lake City, Utah, 1942; 1 vol.

Shopwork Manual No. 1081 in the series of instruction books prepared for pre-employment and upgrading training of civilians employed at Army Air Depots and Sub-Depots. Job, operation, and information sheets are included.

Notes for Air Raid Wardens Concerning Civilian Morale and Panic, by George S. Goldman; The New York City Committee on Mental Hygiene of the State Charities Aid Association, New York, 1942; 7 pages, $0.10.

Prepared for the Emergency Committee of Neuropsychiatric Societies of New York City, this pamphlet is concerned with the problem of promoting among the civilian population a psychologic resistance to panic caused by air raids. It also recommends definite procedures for treating hysteria in individuals as well as groups.

Airframes, Basic Training Manual, edited by V. A. Pope; Sir Isaac Pitman & Sons (Canada) Ltd., Toronto, 1941; 45 pages, $0.15.

Intended for the official use of the Air Cadets of Canada, this manual deals with the basic principles of aircraft structures. It discusses structural considerations, types of air frames and air-frame units, and diagnoses and cures for various flying faults.

The Plastic Flow of Metals, by Earle B. Norris; Bulletin No. 27, Engineering Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va., 1936; 30 pages, $0.20.

Bulletin No. 27 of the "Engineering Experiment Station Series" is devoted to a study of the plastic flow of metals and alloys. The results of the data given are summarized to indicate the possibilities of a law of plastic flow.

Papers on Helical Compression Springs, by H. C. Keysor, D. H. Pletta, and F. J. Maher; Bulletin No. 47, Engineering Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va., 1941; 33 pages, $0.25.

Three papers are included in this bulletin, all of which have resulted from a cooperative project for the study of the elastic behavior of helical compression springs sponsored by American Steel Foundries and the Virginia Engineering Experiment Station. Paper I, "Calculation of the Elastic Curve of a Helical Compression Spring" and Paper II, "Helix Warping in Helical Compression Springs," were presented at the Annual Meeting of the American Society of Mechanical Engineers in Philadelphia, December 4–8, 1939. The third paper is a later contribution on the general subject and is entitled "Load Deflection Characteristics of Helical Springs."

Civil Flying Control and Regulations, by D. G. Joy; Sir Isaac Pitman & Sons (Canada) Ltd., Toronto, 1941; 57 pages.

An outline of Canadian air regulations, together with a study of the conditions under which air transportation may be carried on in Canada. The book is divided into chapters headed general, aircraft, personnel, airports, airways, aids to navigation, signals, traffic, miscellaneous, accidents, and international traffic. A bibliography of reference books for more specific information is appended.

The Torsional Properties of Round-Edged Flat Bars, by D. H. Pletta and F. J. Maher; Bulletin No. 50, Engineering Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va., 1942; 27 pages, $0.25.

Number 50 of the "Engineering Experiment Station Series" describes the results of a project for obtaining the torsional properties of two types of round-edged, flat bars used for helical-compression spring bar stock. Two methods of determination were employed: (1) experimental, by means of soap films and (2) analytical, by means of iteration. Details are given on the apparatus and techniques used in the experiments.

Teacher's Source Material on Aviation, prepared by Division of Curriculum; Los Angeles County Schools and Work Projects Administration, Los Angeles, 1940; 182 pages.

One of the "Industrial Units Series," this monograph offers curriculum material for the study of aviation in elementary schools. It covers types of planes, principles of flight, uses of the airplane, airways, meteorology, aircraft engines, aircraft instruments, aircraft radio, airports, jobs in aviation, parachutes, and highlights in the history of aeronautics.

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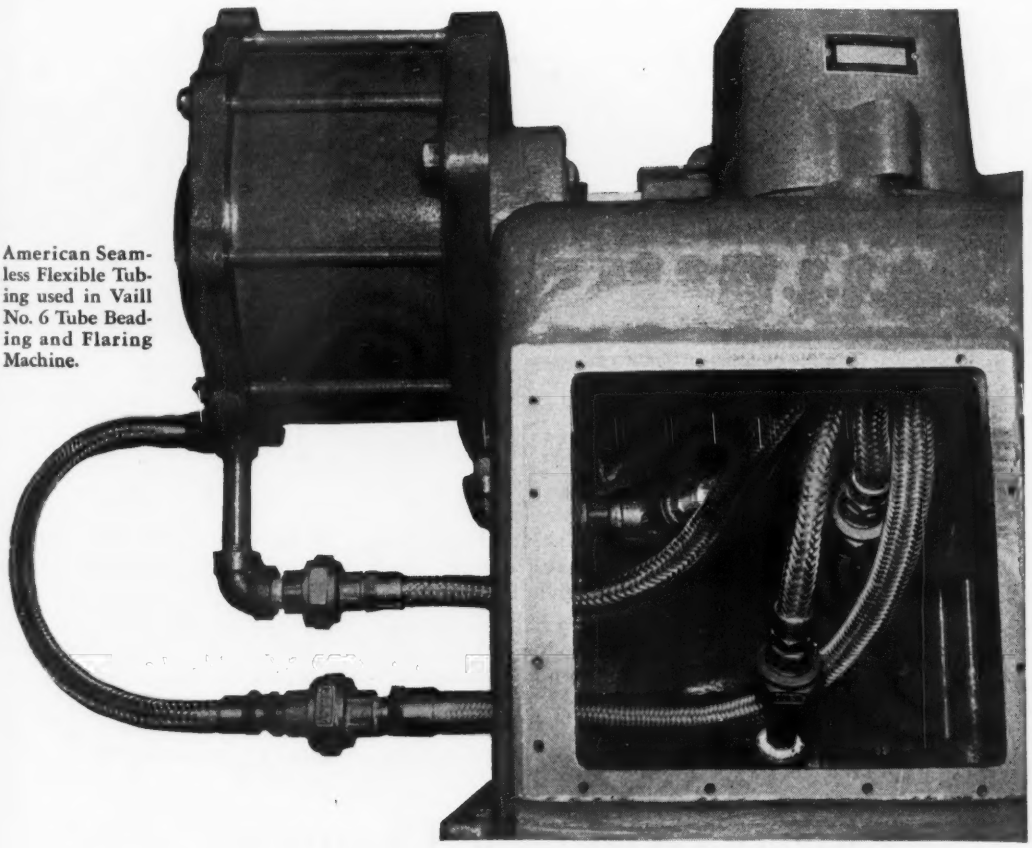

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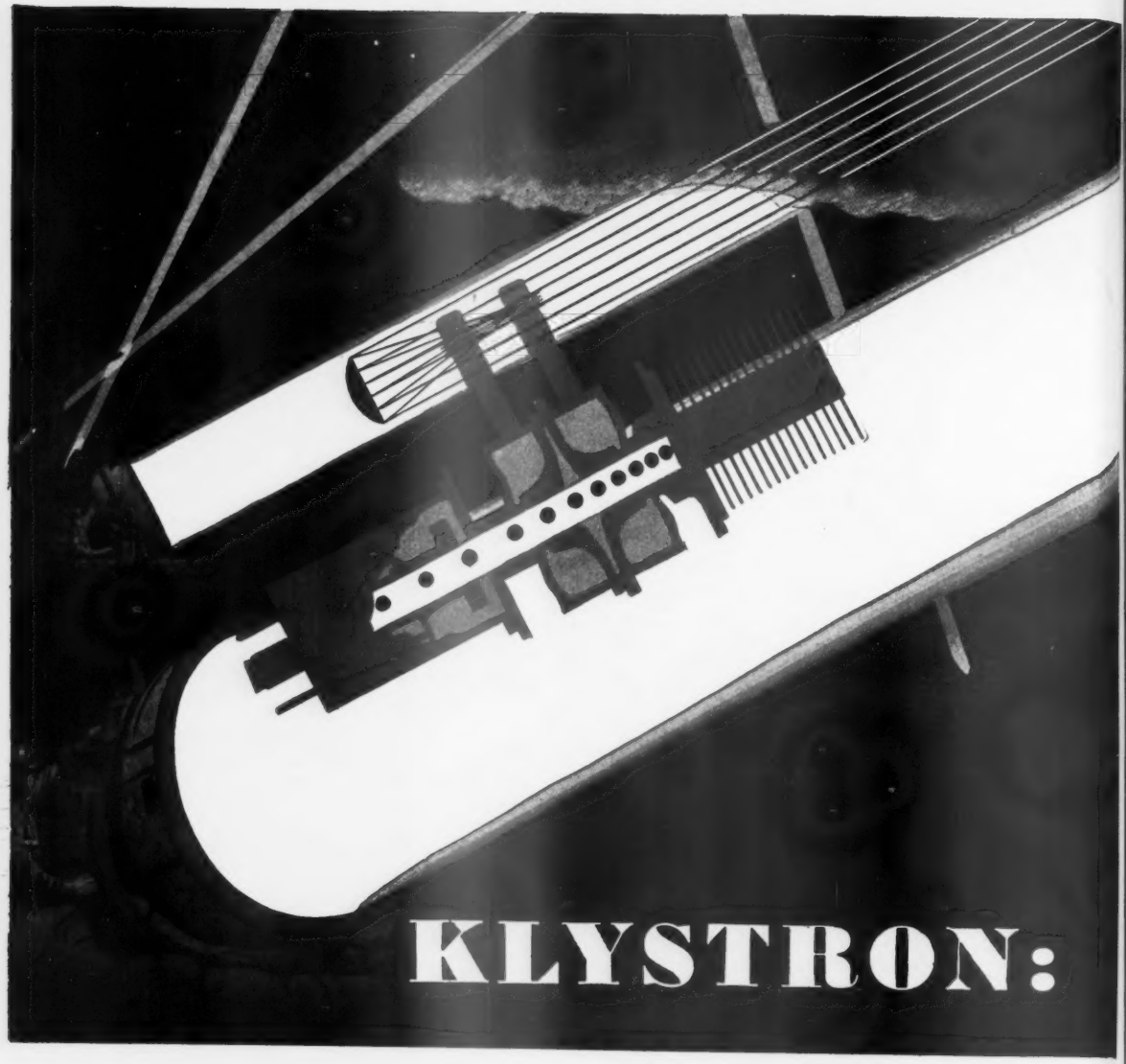

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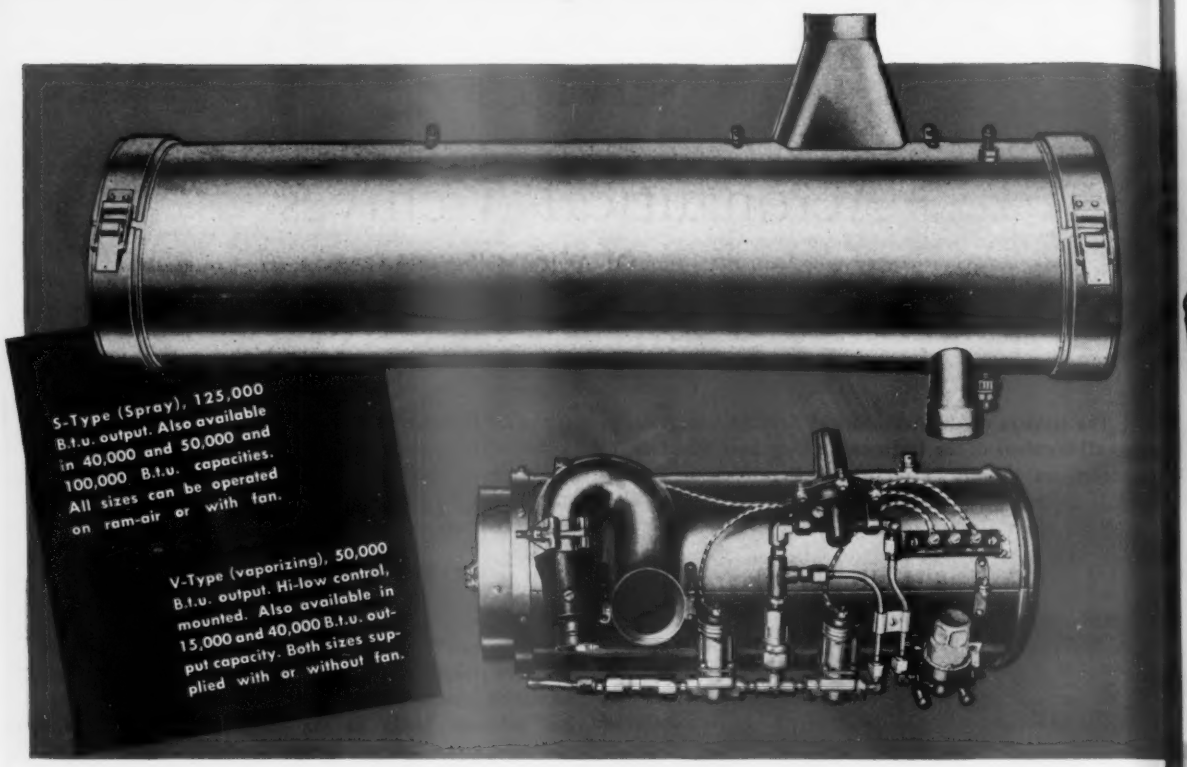

S-Type (Spray), 125,000 B.t.u. output. Also available in 40,000 and 50,000 and 100,000 B.t.u. capacities. All sizes can be operated on ram-air or with fan.
V-Type (vaporizing), 50,000 B.t.u. output. Hi-low control, mounted. Also available in 15,000 and 40,000 B.t.u. output capacity. Both sizes supplied with or without fan.

Backed by more than 30 years of combustion research

THE Janitrol Aircraft Heater and Portable Ground Heater are the latest in a long list of important heating advances, based on research and development work by Surface Combustion. Thousands of these heaters are now being used in United Nations' ships.

Surface Combustion is America's oldest and largest manufacturer of gas-fired industrial and domestic heating equipment and has pioneered in improving heating processes for many uses.

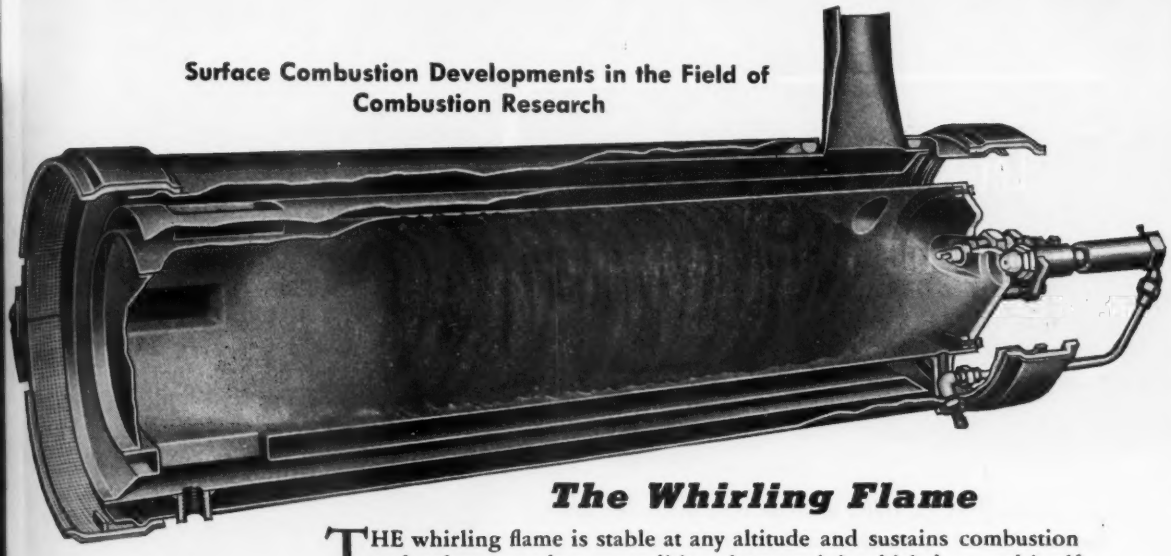
Janitrol Portable Ground Heater (Model No. PBS-250-44) equipped with gasoline engine or electric motor. Adjustable louvered outlet shown.

Surface Combustion developments include One-Way-Fired Soaking Pits for steel mills, heating and heat-treating furnaces for a wide variety of industrial uses, special atmosphere generators, Kathabar systems for humidity control, the radiant tube heating element, the Conjecto Firing System and more than 50 types and 500 sizes of automatic proportioning burners.

The Janitrol Aircraft Heater, based on the Whirling Flame principle, was a logical addition to these other Surface Combustion heating developments. It was specifically designed to operate at all altitudes and to provide fast, positive lighting at temperatures down to 70 degrees below zero.

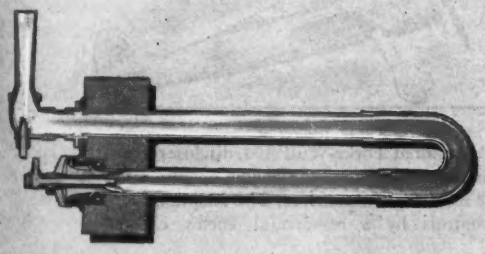
The unique facilities of this company, with more than 30 years' experience in successfully solving heating problems, are available to help you work out the heating systems of your new ships. Write to Surface Combustion, Aircraft Heater Division, Toledo 1, Ohio.

Surface Combustion Developments in the Field of Combustion Research

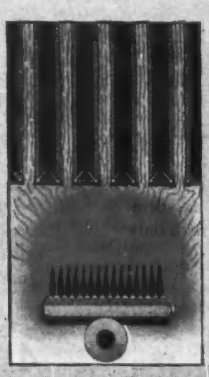


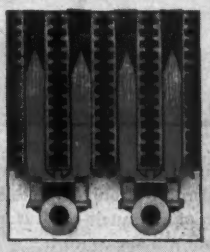
The Whirling Flame

THE whirling flame is stable at any altitude and sustains combustion under the most adverse conditions because it is whirled around itself many times. Thus ignition is continuous and the combustion process is "self-piloting". The whirling is produced by introducing air into the cylindrical combustion tube tangentially to its inner surface. The liquid fuel enters the combustion tube through a vaporizer or spray nozzle ahead of the combustion air inlet.

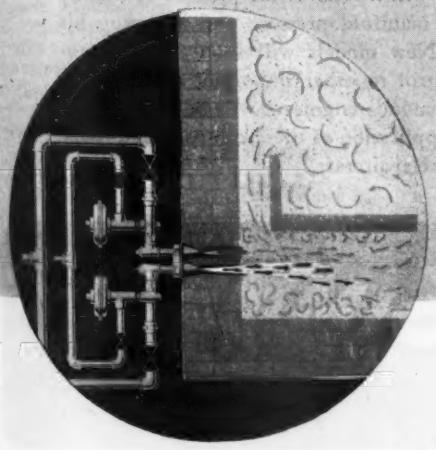


THE RADIANT TUBE—An outstanding development in the field of heat-treating, widely used in the aviation, automotive, steel, non-ferrous and light metal industries.





THE MULTI-THERMEX HEAT EXCHANGER—A compact, efficient and long-lived development for domestic furnaces which eliminates the necessity for the conventional combustion chamber (left), permits the designing of much smaller, more compact furnaces (above).



CONJECTO FIRING—A firing system which permits rapid heating and very accurate control of temperatures over a wide range, for such operations as drawing, annealing, hardening, normalizing and carburizing.

SURFACE COMBUSTION

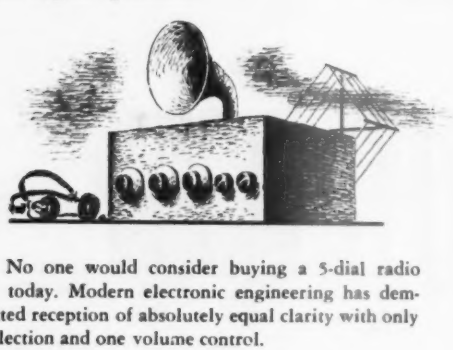
Janitrol

AIRCRAFT HEATERS

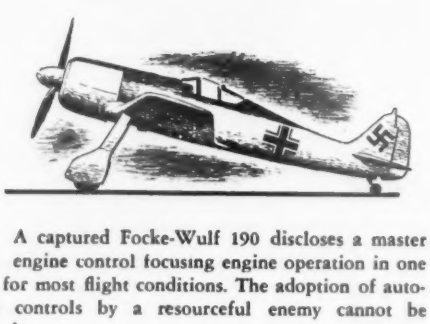
with the whirling flame

Let SIMMONDS take over part of the Control Room Job

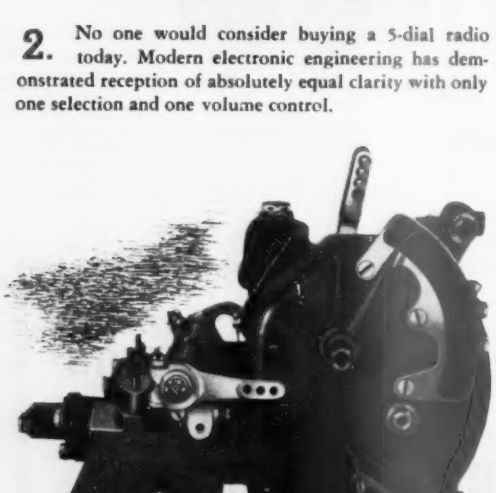
1. Contrary to the trend in other technical fields, the number of instruments and controls tends to increase with the power and size of aircraft. But just as complex conditions in other fields are being handled automatically, the Simmonds-Hobson Automatic Engine Control provides for the known variety of conditions in aircraft engine operation.



2. No one would consider buying a 5-dial radio today. Modern electronic engineering has demonstrated reception of absolutely equal clarity with only one selection and one volume control.



3. A captured Focke-Wulf 190 discloses a master engine control focusing engine operation in one lever for most flight conditions. The adoption of automatic controls by a resourceful enemy cannot be ignored.



4. Simmonds is now producing a proven control which relieves the pilot of constantly watching manifold pressure and adjusting his mixture. New models will soon extend automatic control to other important engine functions. Simmonds engineers will be glad to discuss the application of these controls to military or commercial aircraft.

SIMMONDS EQUIPMENT FLIES WITH EVERY TYPE OF ALLIED AIRCRAFT

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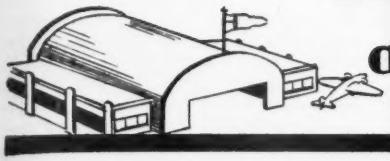


Air Transportation

Air Transportation in the immediate Post-War Period. B. A. McDonald and J. L. Drew. A ring-bound book of 165 pages gives the results of a detailed investigation of future air-transportation possibilities, including estimates of the expected traffic and the equipment necessary. These estimates are stated in specific quantitative terms for each year, definite figures being essential to realistic planning. The difficulties of making such specific forecasts are realized in view of the uncertainties regarding postwar air transportation. Allowances have been made for new developments that may take place and for information that may come to light to disprove some of the assumptions. However, it is believed that the estimates are conservative and that such revisions as may be necessary will be in an upward direction.

Because the years immediately following the war are likely to represent a critical period for the aircraft industry, this study concerns itself principally with that period rather than with long-range possibilities. Another reason for limiting analysis to the few years immediately following the war is that a short-term projection can be made on a fairly rational basis, while a long-term projection must necessarily be based entirely on conjecture. The markets considered in the study include the United States domestic market, incorporating operations between the United States and Canada; the United States and international market, comprising operations of United States companies between the United States and other countries, as well as the operations of the American-flag carrier subsidiaries conducting business abroad; and the foreign market, including the operations of foreign-flag carriers in selected foreign areas.

In general, the plan of the report is, first, to analyze the possible costs of postwar air-transport operation, giving consideration to improvements in plane design and in operating techniques and facilities, as well as to other developments that may affect standards of service and costs of operation. From these operating costs are developed prospective rates that would be economically feasible. Utilizing cost and rate analyses, separate estimates are made of traffic and of equipment for each of the major markets. In most instances the traffic estimates are made by segregating the parts of surface traffic that appear most susceptible to air transport and projecting these into the postwar period. The projections give consideration to such influences as previous trends, estimated level of the national economy, comparative rates and service, air-line route expansion, and new traffic likely to be created by the availability of air transport. Estimates of equipment requirements, based on an analysis of traffic characteristics and aircraft performance, are then derived from the traffic estimates. *Curtiss-Wright Corporation, Airplane Division, Business Research Department.*

Production Record

Two years of Industrial teamwork for more airpower per hour! The record of the aircraft industry's achievement in producing more planes with fewer workers and at less cost is reviewed. It gives figures showing the total number of airplanes, air-frame weight, and percentages of increase of the seven companies constituting the Aircraft War Production Council. The reduction in man power is noted, as well as the declining trend in the cost per pound of manufacturing airplanes. The history of the Aircraft War Production Council is recounted, together with the story of the expansion of the idea of industrial cooperation to speed the war effort. One article tells how the council works in the matter of production and man power. Other subjects are the organization of community aid for recruiting additional workers and the services of child-care centers that were established to facilitate the employment of women. The figures are visualized with the help of drawings, graphs, charts, and tables. *Warplane Production,* March-April, 1944.

Wing Installation

Clockwork on the Wing Line. The activities of the wing-installation shop of the Boeing Aircraft plant are outlined. How the whole process of wing assembly is geared so that each mechanic and each crew finishes his part of the job simultaneously with the others is described. *Boeing News,* May, 1944.

Pipe-Thread Gauge Catalogue

ANPT Pipe Thread Gauges by Pratt & Whitney is a catalogue of 8 pages containing descriptions and illustrations of pipe-thread gauges and the purposes for which they are used. *Pratt & Whitney Division, Niles-Bement-Pond Company,* West Hartford, Conn.

Engine Parts Subcontractor

Precision is their Business. The N. A. Woodworth Company, a firm engaged in the manufacture of precision parts for aircraft engines, is the subject of this article. Its history is outlined and information is given about some of the fundamental principles upon which its operating procedures are based. Among the phases of the business touched upon are the training of its personnel, its production-control methods, and its progressive inspection conveyer system. Some brief biographical details about the founder of the company are included. *Trade Winds,* May, 1944.

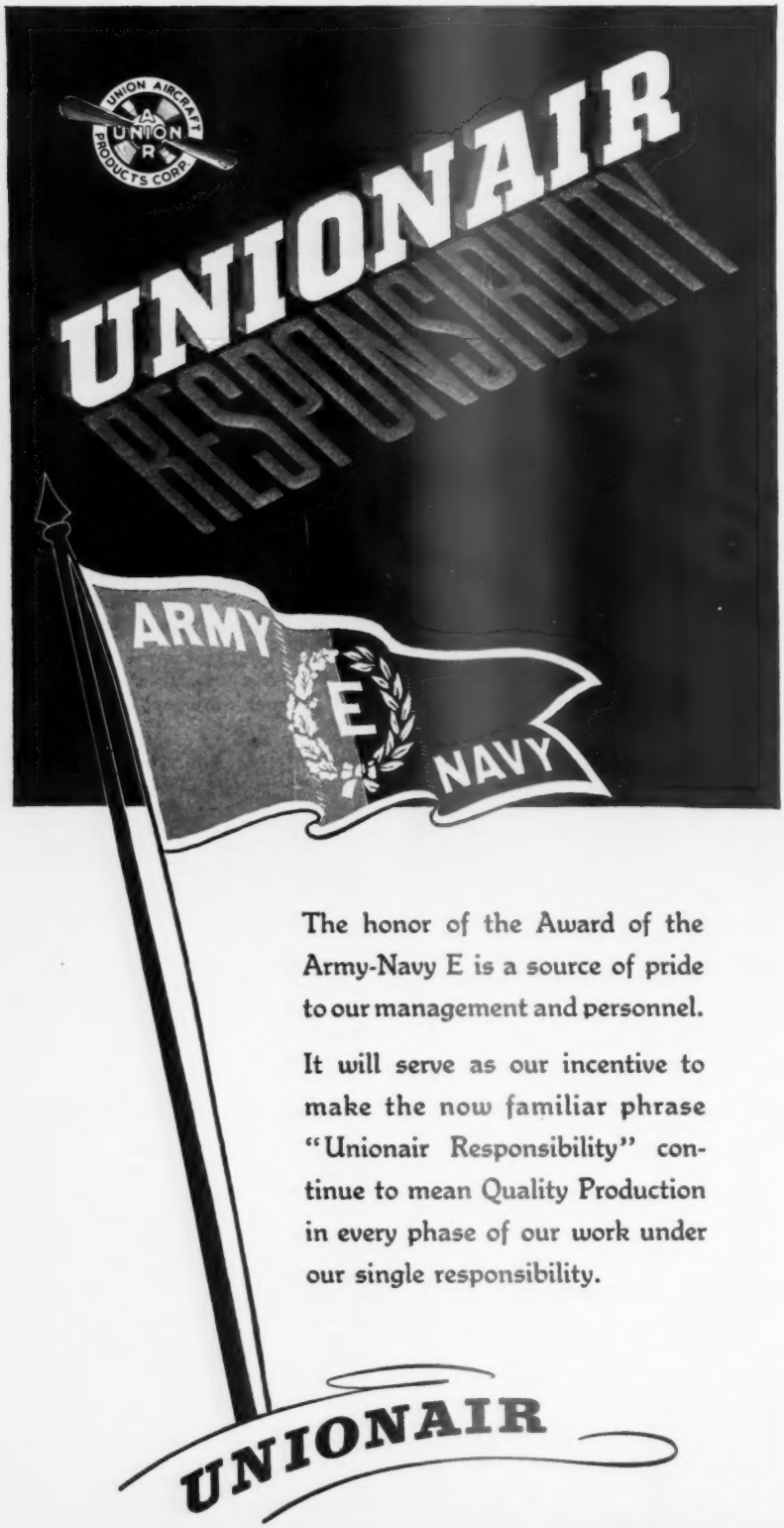
Pioneer Instrument Catalogue

Service Bulletin 41-14A refers to the operation of diaphragm assemblies of the Autosyn Differential Fuel Pressure Transmitters.

A revised list of publications for May and June, 1944, contains an index of technical information about Pioneer aircraft instruments arranged alphabetically under each instrument classification. The publication number, title, and type number covered are listed. This is for inclusion in the Pioneer instrument catalogue and is numbered section 44-13B, superseding 42-16B. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*

Operations in the Central Pacific

Air Leaps Toward Tokio. This series of observations transcribed from an interview with Major Gen. Willis H. Hale, Commanding General of the U.S. Army Seventh Air Force, describes the difficulties of air fighting in the Central Pacific, reviews some of the operations of the Seventh Air Force, notes some of their procedures, outlines the pattern of their strategy, and tells of the goal toward which they are fighting. Problems of distance and weather conditions are stressed. Interpreting the significance of the air campaign in the Marshalls and the bombing attacks on the Gilberts and Carolines, the General reports that it is the purpose of the Seventh to render ineffectual every island group that stands between the Allies and the Japanese homeland. He also states that the Marshalls campaign has demonstrated the facility with which the land-based aircraft of an Army Air Force can support and cooperate with the Navy and amphibious forces. *Plane Talk,* May, 1944.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Molded Structures

Duramold. An illustrated catalogue gives information about Duramold and its uses. It traces the development of the material and shows how it is made and how it is applied to the manufacture of aircraft. A section includes information concerning methods of processing the material by means of electronics. The concluding pages give some suggestions for the use of Duramold in postwar civilian goods. *Duramold Division, Fairchild Engine and Airplane Corporation,* New York.

Fractional-Horsepower Motors

Out of Thin Air is a new brochure prepared to tell something of the story of strides made in the design of fractional-horsepower motors since the beginning of the war. This booklet, illustrated in color, explains how the exacting standards imposed upon motor manufacturers by the requirements of aircraft applications have compressed years of normal development in motor design into a few months. These new motors are claimed to incorporate safety and protective devices, versatility, controllability, and durability. *The Dumore Company,* Racine, Wis.

Waco Aircraft Manual

Two sets of mimeographed sheets give data about all Waco aircraft. The information is supplied for the assistance of those desiring to purchase used Waco aircraft. One list gives information about all Waco cabin aircraft and the other list refers to the manufacturer's open models. The lists give the model designation, general description, and detailed specifications, including price of each year's products. The list of open models begins with the airplanes produced from 1929 through 1942, and the list of cabin airplanes includes those produced from 1931 through 1942. The manufacturer states that additional information will be given to interested parties on request. *The Waco Aircraft Company,* Troy, O.

Annual Report

Report to Employees of General Motors for the Year 1943. A popularized version of the annual report of General Motors Corporation is intended to convey information to the corporation's employees regarding the progress made in the past year. The textual matter is written in easily understood language. Graphic illustrations show the corporation's operations; the earnings statement and balance sheet are set forth in simplified terms. A chart shows that, of the corporation's total war production in 1943, amounting to $3,547,000,000, aviation production accounted for 41 per cent and was larger than any other part of the total output. Trucks accounted for 11 per cent; tanks, 18 per cent; Diesel engines, 11 per cent; guns, 13 per cent; and miscellaneous, 6 per cent. *General Motors Corporation.*

Great Pictures of the War . . . made with

Fairchild CAMERAS

Official U.S. Navy photograph

An old story to camera fans is the above famous Pearl Harbor picture. But surprising news to most folks is that it was made not with a standard *still* camera . . . but with a Fairchild precision *aerial* camera!

Action shots on land and sea, as well as from the air, are made with Fairchild cameras. Why? Because no matter how swift the action . . . no matter how far from the photographer it may recede . . . the Fairchild camera still gets accurately detailed close-ups.

With focal lengths up to 60-inch, Fairchild cameras could make recognizable shots of your living-room furniture from two miles up . . . and do it in the black of night as well as in the light of day.

These are the reasons why many great pictures of the war, on land and sea too, are made with Fairchild precision aerial cameras.

Destroying Jap planes in Marianas Islands — a Ziff-Davis Pub. Co. photo — one of a series also taken with a Fairchild Aerial Hand Camera.

Fairchild CAMERA AND INSTRUMENT CORPORATION

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THE STORY OF AERIAL PHOTOGRAPHY IS THE STORY OF FAIRCHILD CAMERAS

3 helpful time-savers for the LABORATORY

GAGE POINT PUNCH

1. Time-Saver No. 1 . . . automatically centers either round or flat specimens. Marks four uniform 2-inch gage-length centers with one push of the handle. Automatically adjustable to suit soft or hard materials. Accommodates rounds ⅛" to ¾" dia.; flats ½" to ¾" wide and zero to ¾" thick.

PARALLEL RULER

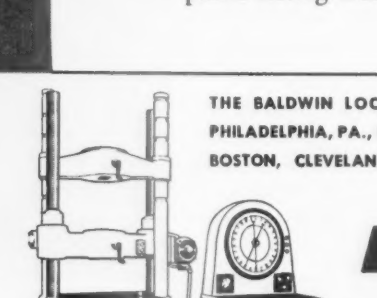
2. Time-Saver No. 2. This parallel ruler assembly facilitates and simplifies the rapid determination of yield strength, and data from stress-strain curve.

EDGE-COMPRESSION TESTING JIG

3. Time-Saver No. 3. This simple inexpensive new jig permits direct determination of compression yield strength from a single test sheet, rather than use of a pack. Simplifies testing technique.

BALDWIN PRODUCTS

Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.



THE BALDWIN LOCOMOTIVE WORKS, BALDWIN SOUTHWARK DIVISION, PHILADELPHIA, PA., U.S.A. OFFICES: PHILADELPHIA, NEW YORK, WASHINGTON, BOSTON, CLEVELAND, CHICAGO, ST. LOUIS, HOUSTON, SAN FRANCISCO

BALDWIN
SOUTHWARK
TESTING EQUIPMENT

BLW THE BALDWIN GROUP

Storage Batteries

Facts is the title of a 48-page illustrated catalogue containing a compilation of revealable facts about wartime storage batteries. Statistics about the production and use of storage batteries are given in chart and text, and current types of batteries are described and illustrated. Among the features are the polystyrene containers and Fibrite insulation. The transparent polystyrene containers are stated to be immune to the corrosive effects of electrolyte and to be strong, light, and easy to clean.

The Fibrite insulation is made from noncritical materials and is claimed to retard shedding of active material from plates so that it is possible to utilize the space heretofore set aside for sediment in earlier types of batteries. This permits the use of larger, higher-capacity plates with no increase in overall cell size. Other features are the nonspill construction, specific-gravity indicators molded into the containers, and the provision for dry-charge shipment. *Willard Storage Battery Company*, Cleveland.

The Catalogue of Actuating Units

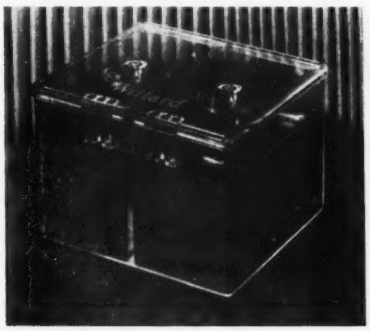
Interstate Aircraft Precision Units, Catalogue A-44 contains illustrations and brief descriptions of numerous aircraft and armament actuating units, operated electrically, hydraulically, pneumatically, and manually. These consist of electric bomb-shackle assemblies and electric, hydraulic, pneumatic, and manual gun chargers. Other items listed are hydraulic actuating cylinders for landing gears, dive brakes, wing flaps, and other purposes, as well as relief valves and similar types of equipment. Information is also given about research for the development of special products on a "custom-built" basis. *Interstate Aircraft and Engineering Corporation*, Los Angeles.

Engine Specifications

Publication has been resumed, on a periodical basis, of information about unrestricted engines in current production. An index sheet gives tabulated specifications for Wasp Junior, Wasp, Twin Wasp, and Double Wasp engines. Changes from previous editions are printed in red ink for ready reference. Other sheets give detailed specifications, descriptions, dimensions, and performance figures, as well as power curves applying to the various engine models listed. *Pratt & Whitney Aircraft Division, United Aircraft Corporation*, East Hartford, Conn.

Conditioning Aluminum Alloy

Marauders Get Conditioning Baths. The processes followed in treating aluminum alloy by heat and chemicals, as utilized in the plant of The Glenn L. Martin Nebraska Company, are described. Details are given on the method of heat-treatment in a special nitrate salt solution to impart the desired properties to the aluminum alloys used in the construction of the B-26 Marauder. It describes how the processes are divided into four steps: placing the parts in charging racks; immersion into the molten nitrate salt bath; quenching in cold, circulating water; and rinsing all remaining salt from the treated aluminum alloys. *Inco*, Spring Edition, 1944, Vol. 19, No. 2.



This 4-volt Willard storage battery has a capacity of 42 amp.-hours at the 20-hour rate. It weighs 11 lbs.; has a built-in specific gravity indicator; and is $6^{1}/_{4}$ in. long, $5^{5}/_{8}$ in. wide, and $4^{3}/_{16}$ in. high.

Cable Fasteners

Wire Harness Bands with Resilient Lining is an illustrated catalogue of 16 pages describing the construction, installation, and use of fasteners for holding in place electric cable harnesses. The bands are lined with sponge rubber and are attached to the fuselage by special snap-on clips. Advantages claimed are ease of attachment, ease of servicing, cushioning of the wires, secure fastening, and resilient lining. It describes the special attaching clip that requires no bolts, nuts, or screws. Various types of fasteners and attaching clips are described and illustrated, with drawings giving dimensions. *United-Carr Fastener Corporation*, Cambridge, Mass.

Low-Temperature Plastic

Too Cold? Not for Dibutyl Sebacate. The properties of a plasticizer named dibutyl sebacate are explained and its uses are outlined. It is an ingredient used in the manufacture of certain synthetic rubbers to maintain flexibility under low-temperature conditions. Among other things, it is used in gas masks and in the lining of self-sealing gasoline tanks for aircraft. Its physical properties are described. *The Resinous Reporter*, May, 1944.

Assembly-Line Production of Quartz Crystals

How Quartz Crystals Are Manufactured is the title of a new illustrated booklet. The booklet is a reprint of five articles, written by Sidney X. Shore, Senior Engineer of the North American Philips Company's Crystal Division, that recently appeared in a technical journal. Subjects covered are: Inspection, Grading and Classification of Quartz; Orientation of Crystals; Sawing and Orientation Devices; Lapping and Finishing; and Crystal Testing. In addition, some predictions concerning the future of quartz in the postwar era are included. *North American Philips Company, Inc.*, New York.

Air-Age Globe

Air Globe. A new type of globe that is intended to help visualize the coming age of air transportation. It eliminates the conventional boundary lines of continents and nations, but the names of cities are so printed that they give a rough outline of the bodies of land on the earth. The globe is not fixed on an axis but rests on a base so that it may be studied from any desired position, emphasizing the fact that any point on the globe is the "top of the earth." The globe is accompanied by a flexible ruler made of transparent plastic, to be used for measuring the air distance between points. The ruler is calibrated in statute miles and also in units of time based upon a transport-airplane speed of 250 m.p.h. The globe, which was created and designed by P. P. Willis, is produced, copyrighted, and marketed by Rand McNally & Company, of Chicago. It is accompanied by an explanatory booklet containing an alphabetical list of the place names and a listing of those places by countries. *American Airlines, Inc.*

Surface Finishing of Engine Parts

Face Value Does Count. In addition to interpreting the importance of fine surface finishing in the production of Cyclone engine parts, this article notes the methods by which the smooth surfaces are created. The possibility of damage in the surface becoming a starting point for a break through the whole part is given as the main reason for fine surface finishing. Honing equipment, lapping machines, buffers and polishers, surface analyzers, and profilometers are named as some of the machines that assist in the prevention and detection of surface imperfections. *Trade Winds*, May, 1944.

Adjustable Clamps

Grand Speed Clamps. A 32-page catalogue describes various types of alloy steel and malleable iron clamps for holding parts in process of manufacture and assembly. Clamps used in the production of aircraft are included in the publication. *Grand Specialties Company*, Chicago.

Plywoods in Construction

Plywood Wartime Uses. Reprinted from *The Timberman* for January, 1944, the booklet reviews the uses of plywood in the construction of doors for aircraft hangars and in the construction of airplanes, including the Flying Fortress and the Airacobra. Other uses for plywood at air bases are shown, as well as applications of the material in other industrial and naval construction work. *Douglas Fir Plywood Association*, Tacoma, Wash.

Have you this kind of Faith in your instruments?

IF YOU didn't have faith in your alarm clock you'd spend a restless night. As it is, you sleep soundly because you know that this clock won't fool you —at least not more than once.

But an electrical instrument is different. It doesn't reveal it's faithlessness by ringing at the wrong time or by letting you oversleep. It may slowly begin to vary just a little from the truth, and this may not be discovered until great damage has been done.

The only way you can enjoy complete faith in your metering, measuring and testing equipment is to know how it is made. In the case of Boes instruments, we invite this kind of acquaintance. We want you to know how we engineer our instruments, how we earn your faith and confidence by building Boes instruments to meet incredibly stiff standards, how we provide for *sustained accuracy*.* We believe that an investigation of our facilities, our products, and our methods will reward you with complete confidence in any Boes instrument that you may ever use.

• • • • • •

***SUSTAINED ACCURACY** is not an easy quality to achieve. It must take into account all factors of use—must then employ the design, the alloys, the construction that infallibly protect an instrument against all threats to its reliable performance. Such instruments, obviously, must be built with performance—not price—in mind. We invite the inquiries of those who are interested in such standards.

Boes *instruments*

for Measuring, Metering & Testing Equipment ☆ The W. W. Boes Co., Dayton, Ohio

Aircraft Instrument Catalogue

Kollsman Aircraft Instruments: Flight, Navigational and Engine Instruments. A new 16-page condensed version of the catalogue showing the standard line of Kollsman aircraft-flight, navigational, and engine instruments has been published. Included in the publication is a list of the company's current production types, full-size dial views of many of the standard instruments, and information about several new types, including a sensitive air-speed indicator and a heated pitot tube. Corresponding Army and Navy type numbers are given, as well as Kollsman designations. *Kollsman Instrument Division of Square D Company,* Elmhurst, N.Y.

Reduction of Accidents in Sheet Metal Shop

Safety Through System. Methods and routines that form the basis of safety practice in the sheet metal department at Vultee Field are related. The described safety program is credited with having effected a decline in the accident rate. *Plane Talk,* May, 1944.

Ball Reciprocating Bearings

High Capacity Ball Reciprocating Bearings. A folder has been issued describing high-capacity ball reciprocating bearings for aircraft. These bearings are produced for applications where antifriction qualities are required in rotation, reciprocation, oscillation, or their combinations. The construction employs a helix to separate the balls and retain them, thus permitting the use of about twice as many balls as in the conventional sleeve-type retainer. The specifications of the bearings are listed. *The Torrington Company, Bantam Bearings Division,* South Bend, Ind.

Magnesium Development

Dow and Magnesium. A booklet has been issued containing the statement filed by Willard H. Dow, President and General Manager of the Dow Chemical Company, with the Special Committee of the United States Senate Investigating the National Defense Program (the Truman Committee), at Washington on March 6, 1944. Also included are extracts from the oral statement made by Dr. Dow, an extract from the cross-examination, and extracts from the report of the Committee.

The booklet describes the birth of the magnesium industry, the problems the Dow Chemical Company had to surmount in developing a commercial process for producing magnesium, the development of satisfactory magnesium alloys, the struggles for markets, and problems of foreign and domestic competition. *The Dow Chemical Company,* Midland, Mich.

No "Easy" Victory over Japan

Problems in Bombing Japan. Randall Gould. The writer disputes the theory that Japan is particularly vulnerable to air raids. From his experience as a resident of Japan he claims that, contrary to general opinion in these matters, the construction of Japanese houses is particularly flexible to withstand shock and concussion, the people are prepared physically and psychologically for air raids, the industries are so organized as to make disruption of them extremely difficult, and weather conditions of the island group are particularly unfavorable to sustained bombing raids. Warning that the real war with Japan has not yet begun, he also points out that the Allies have yet to take the bases on the Chinese coast that they require and that there is the further difficulty in supplying such bases with the quantities of materials that great air missions need. *Plane Talk,* May, 1944.

Engine Handbook

Enginology is a booklet compiled from a series of articles that appeared in the manufacturer's weekly newspaper for employees for the purpose of imparting knowledge of the design, construction, and operation of a radial aircraft engine. The introductory pages give the fundamental principles upon which an internal-combustion engine operates. Other pages explain the individual parts of the engine and how each performs its function in relation to other parts and to the complete engine. Descriptions of the engines recently produced and the manner in which the engines are mounted and used on airplanes are given. The concluding pages contain lists and pictures of the airplane types that use these engines. *Wright Aeronautical Corporation.*

Investment Survey

Security and Industry Survey is an annual booklet combining analyses of numerous industries for the benefit of investors. One section is concerned with a discussion of the aircraft manufacturers and another with the air-transportation companies, the stocks of which are listed on the New York Stock Exchange. A discussion of the current position and postwar outlook of these investments is supplemented by statistical data concerning the earnings of the companies and the price ranges and current yields of the stocks. *Merrill Lynch, Pierce, Fenner & Beane,* New York.

Flowmeter Catalogue

A New Era in Flow Rate Measurement is a 32-page illustrated catalogue describing the Rotameter, an area-type flowmeter for measuring the flow rate of liquids and gases. The design principles of the instrument are discussed, with an explanation of how it works, how it can be made immune to variations in viscosity and specific gravity, and why it gives accurate measurements. A list is included of the varieties of fluids that the instrument has measured, as well as some typical applications. It is illustrated by photographs, drawings, and some humorous sketches. *Fischer & Porter Company,* Hatboro, Pa.

Fuel System Improvements

Finding the Key to Vapor Lock. Some notes on the procedures and methods by which Curtiss-Wright's Research Laboratory is investigating the limits of temperature and altitude within which the fuel systems of Curtiss aircraft will operate. The nature of vapor lock and the damages it can cause in the functioning of an airplane are explained. *Curtiss Fly Leaf,* March-April, 1944.

Current List of Warplane Types

American Warplanes is a 4-page folder giving a list of the current operational aircraft used by the U.S. Army and Navy. It lists in columns the name of the designer, the name and type designation of the plane, the number and type of engines and the engine builder, and the design, model designation, and blade sizes of the propellers used. The list is classified according to the purpose for which the airplanes are designed, as fighters, light bombers, medium bombers, and heavy bombers. The noncombat craft are classified under the headings of transports, advanced trainers, basic trainers, primary trainers, observation craft, and liaison craft. The list also includes two types of airships, as well as certain British airplanes that use American propellers. *Hamilton Standard Propellers Division, United Aircraft Corporation,* East Hartford, Conn.

Diesels for Private Planes

The Diesel Aircraft Engine for the Private Owner. William E. Lind. The features of the Diesel type of aircraft engine are described to show the suitability of that type of engine for private aircraft in the future. Among the advantages listed are lower cost of fuel, reduced fire hazard, reduced maintenance costs, and simpler controls. A tabulation gives comparisons of the fuel consumption, weight, fuel costs, and other data pertaining to several types of present and projected Diesel engines compared with existing poppet-valve engines for small airplanes for private use. *Guiberson Guidon,* April, 1944.

British Radio Standards

Radio Components for Service Equipment specifications have been published in loose-leaf form for all radio components in the British Standards Radio Components series. These are intended primarily to be used for contracts placed by the Inter-Service (Communications) Components Technical Committee, the Admiralty, the Ministry of Supply, and the Ministry of Aircraft Production, but they may also be used for other purposes where appropriate. In addition to these specifications, a section includes important test specifications and schedules for fixed resistors; test specifications and schedules for fixed capacitors of paper, mica, ceramic, and other materials; and a test schedule for electrolytic capacitors. *British Standards Institution,* London.

Notiz!
North American P-51 Mustang Fighter
Ein Tiefdeckerflügel Eindecker mit langer Nase, langem, schlankem Rumpf, großem bauchwärtigem Kühler, Einzelflosse und
Vierblatt-Propeller. In den Tragflächen montiert: Sechs 50-kalibrige Maschinengewehre
Gilt als das schnellste Flugzeug

ATTENTION LUFTWAFFE! Keep away from this plane. Expect to see it on the farthest trip American bombers make. Expect to see it up high—40,000 feet—but don't expect to see it for long, because the Mustang travels at over 425 m. p. h.

And you can expect to see more and more Mustangs, too. The men and women at North American are stepping up production every month. So when you see this high fighting, far flying Mustang, look out, Luftwaffe. Get out of there quick!

North American P-51 Mustang Fighter
ATTENTION AMERICANS! BONDS bought these planes. WASTE FATS helped arm them. WASTE PAPER helped ship them. GASOLINE flies them. Will YOU help to deliver the next squadron?
FULL-VISION "TEARDROP" COCKPIT ENCLOSURE
DROPABLE WING GAS TANKS, FOR INCREASED RANGE
SIX .50 CALIBER MACHINE GUNS

North American Aviation *Sets the Pace*

WE MAKE PLANES THAT MAKE HEADLINES . . . *the B-25 Mitchell bomber, AT-6 Texan combat trainer, P-51 Mustang fighter (A-36 fighter-bomber), and the B-24 Liberator bomber. North American Aviation, Inc. Member, Aircraft War Production Council, Inc.*

Machine Tools for Engine Building

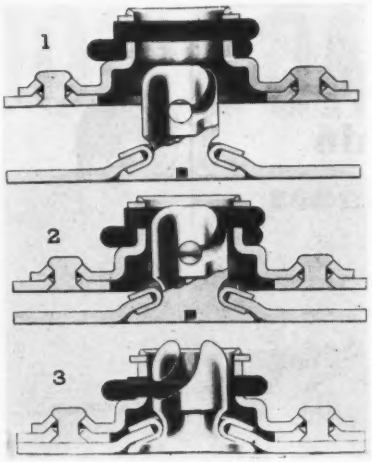
High Production Machine Tools. This 44-page illustrated booklet shows how the application of machine tools has brought about savings in skilled labor, facilitated the employment of women operators, and improved production in the manufacture of aircraft engines. It describes various special operations in which automatic machine tools are used and contains tables of the cost and time figures and the savings effected by the special machines. Among the operations described are those on cylinder heads, machining cylinder assemblies, cylinder-barrel flange holes, spark-plug bushings, metallizing, drilling and reaming lock-pin holes, machining the supercharger front section, diamond-boring counterweights, milling crankcase flanges, reaming and tapping, machining angular holes, and turning and facing reduction-gear carrier rings. Other operations are those on the propeller shaft, nose section, pistons, crankshaft, push-rod tubes, articulated rods, and reduction-drive gears. Services performed by conveyers, furnaces, and other plant equipment also are described. *Wright Aeronautical Corporation.*

Industrial Lubrication Equipment

Four new catalogues have been made available, each describing a new system of centralized lubrication for industrial machinery. The LubroMeter is described as the simplest form of centralized lubrication, having only two moving parts in its valves. The Dual Progressive system is a single-line progressive system of centralized oil or grease lubrication. It provides for the delivery of a predetermined amount of lubricant and is provided with a conductor that gives a signal when the lubrication cycle is completed. The Progressive system incorporates new design and manufacturing features for lubricating a group of three to 20 bearings, feeding each in turn with a predetermined amount of lubricant. The Dual Manifold system is a dual-line system of centralized lubrication, designed for high-pressure grease or oil lubrication, that can be applied to any number of bearings on one machine or a battery of machines. It is a direct hydraulic system by which an adjustable predetermined charge of any type of grease or oil at any temperature may be introduced into all bearings of a machine. The catalogues describe and illustrate these items and equipment and show their operation. *Alemite Division, Stewart-Warner Corporation,* Chicago.

Self-Locking Fasteners

Esna Spring-Lock Fastener is a 36-page booklet that shows how this device is assembled and how it operates. It shows the tests to which the fastener is subjected, these being the operating-torque test, the initial-tension test, the sheet-separation test, the tension-overload test, and tests for shear, vibration,



The method of locking the new Elastic Stop Nut spring-lock fastener is shown here. The stud end of the fastener is shown in position with body (Fig. 1). Fig. 2 shows the stud cam-slot making contact with the spring cross-bar section, and Fig. 3 shows how, with less than a quarter turn, the cam picks up the spring cross-bar, pulls it down past the crest, and snaps it into locked position.

and endurance. A special test shows how the fastener meets the specifications required for installation on sheets bent to a radius of curvature of 18 in. Pages of engineering data give tabulated specifications and scales showing dimensions and applications. *Elastic Stop Nut Corporation of America,* Union, N.J.

Revised List of Products and Personnel

A list, revised May 20, 1944, gives the current personnel and planes produced by the Fairchild Aircraft Division. Detailed specifications are given for each plane, showing the construction, dimensions, equipment, instruments, engines, and performance of those currently in production. Descriptions are given also of aircraft formerly built and similar to the current products. *Fairchild Aircraft Division, Fairchiid Engine and Airplane Corporation.*

Compass System Wall Charts

Two final wall charts of a series show cutaway views of the respective units of the Gyro Flux Gate Compass. One chart refers to the remote electrical gyro-erecting unit and gives a description of the functions of the instrument. The other chart refers to the amplifier and includes a description of its sections and their operation. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*

Flight Contractor's Report

Report of War Service and Preview of Peace Time Aviation. An illustrated booklet of 32-pages reviews the work of a flight contractor of the U.S. Army Air Forces in conducting primary pilot schools. It contains an outline of the personnel and equipment of the organization and its record in giving primary flight training to air cadets. It describes and illustrates the mechanical equipment and the living quarters provided for the students. *Southeastern Air Service, Inc.,* Atlanta, Ga.

Fire-Fighting Equipment

Aircraft Ground Fires . . . and How to Fight Them. Various kinds of fires likely to occur in aircraft on the ground are reviewed and information is given about equipment and methods used in fighting such fires. Seven major fire hazards listed by the Army Air Forces are given. Brief paragraphs show how these fires originate, what action should be taken, and what equipment should be used to extinguish them. *Kidde Industry,* April, 1944.

Supplementary Data for Retaining Rings

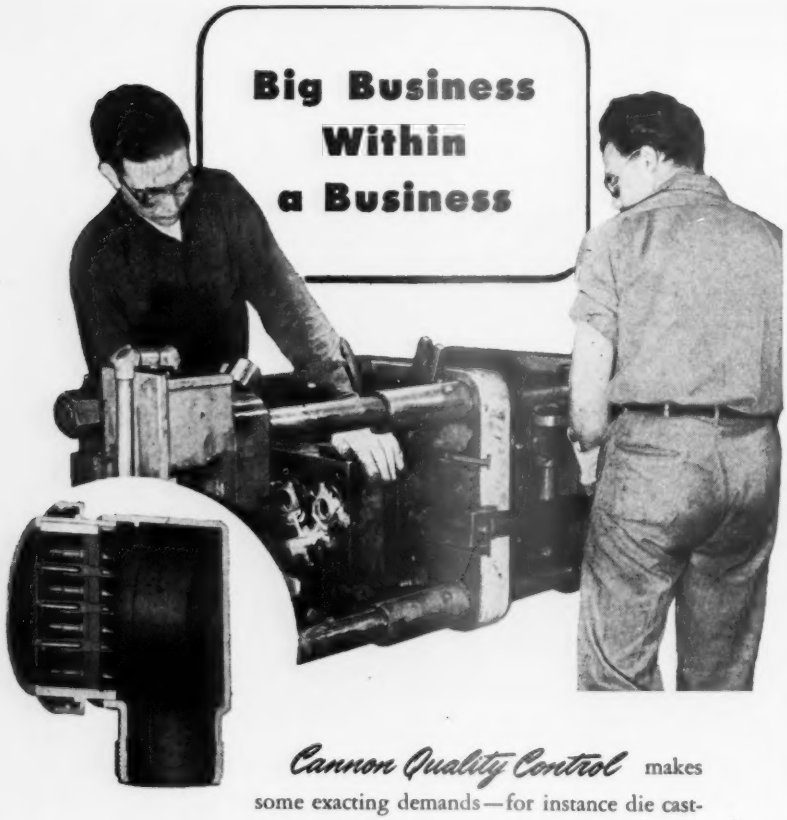
A folder containing engineering data for external and internal types of Waldes Nuarc retaining rings. It gives specifications and dimensions for retaining rings of from 0.125-in. to 10-in. shaft diameter, with figures on the free-diameter, thickness, and groove dimensions. *Waldes Koh-I-Noor Inc.,* Long Island City, N.Y.

Production Suggestions

There's Artistry in Workmanship. A month's suggestions included the following: (1) A felt-breaker machine that center-creases felt stripping and eliminates its tendency to pull away from floor boards after cementing. (2) Adjustable skin-trim jig, to save about 40 per cent of the time formerly required to place and shear predrilled wing skins. (3) Combination hardened drill bushing that can be quickly placed—expected to save nine-tenths of the time required to secure threaded parts in assemblies. (4) A method of nibbling steel fittings that could not be cut with aluminum routing tools. (5) Fixture for checking the size of router bits. *Beech Log,* May 12, 1944.

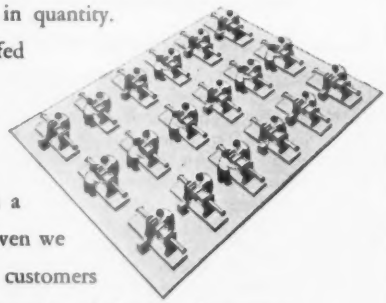
S. M. Lawson Wins $250 for His Joggle Die Idea. Highest award in a contest at North American Aviation, Inc., involving $695 in total prizes, was given for an improvement of a joggle die to form accurately important parts of the B-24. *Take-Off,* May 12, 1944.

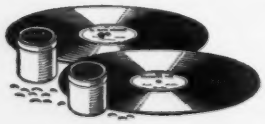
East Hartford Plant Suggestion Award Winners. Awards were given by the Hamilton Standard Propellers Division for the following production suggestions: (1) Two galvanized iron doors for the degreaser in the paint department, which reduce evaporation of trichlorethine; (2) a steel drum containing caustic soda for cleaning the blade-conveyer clamp by means of erosion; (3) wiring of the governor cutout switches from the opposite direction to prevent the wire ends from projecting beyond the screws and scratching the hands of workers; (4) a modified slide rule for inspecting the taper of blade plugs. *The Hamilton Standard Blade,* June 1, 1944.



Cannon Quality Control makes some exacting demands—for instance die castings so intricate and precise that ordinary sources can't supply them profitably and in quantity.

So we built, equipped and staffed our own die casting department. It's a big one—rates among the five largest aluminum alloy die cast plants in the country. It has a huge capacity—much more than even we need. But its size assures our customers prompt delivery of almost any quantity of Cannon Connectors, on short notice without the slightest sacrifice of the well-known Cannon qualities—easier assembly, better fit, greater strength with less weight, longer trouble-free life.





Cannon slide films with sound covering assembly and soldering techniques are available on request. Address Department A-105, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

CANNON ELECTRIC

Cannon Electric Development Co. Los Angeles 31, California

Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto

REPRESENTATIVES IN PRINCIPAL CITIES — CONSULT YOUR LOCAL TELEPHONE BOOK

Ideas! Pay Dividends. Employees in various divisions received awards for the following suggestions: (1) An improved inspection routing of gyro-roton in balancing checkup eliminated about 75 per cent of the rechecking by the old system. (2) A spring-operated frame with pads to cover the holes in the rocker oil-drain sump while painting. (3) Combination of assembly, reaming, and drilling on control shafts and cam shafts for Diesel engines. (4) Combining the drill and seating tool for rough and finish machining of valve-guide holes and valve seats on the Pratt & Whitney engine cylinder head. (5) Eliminating coolant that mixes with fine chips and dulls the cutter, causing excessive cutter usage on the trigger-housing profiling operation for the M-1 carbine. *GM Folks*, June, 1944.

Suggestions. Prize-winning suggestions at Jack & Heintz, Inc., include the following: (1) The forming of field coils by a hydraulic press, with the jig located both at the top and bottom of the press and grooves slotted on the side of the jig so that the coil can be removed more easily. (2) The use of bushings as spacers when grinding parts on a Heald internal grinder. (3) A fixture for salvaging parts of a starter crank. (4) A method of grinding two differently sized rings at one time. (5) The installation of caps on the shaft ends of buffing motors to prevent the entanglement of operators' sleeves. (6) The addition of a curved conveyer section to starting assembly conveyers. *The Jahco News*, May, 1944.

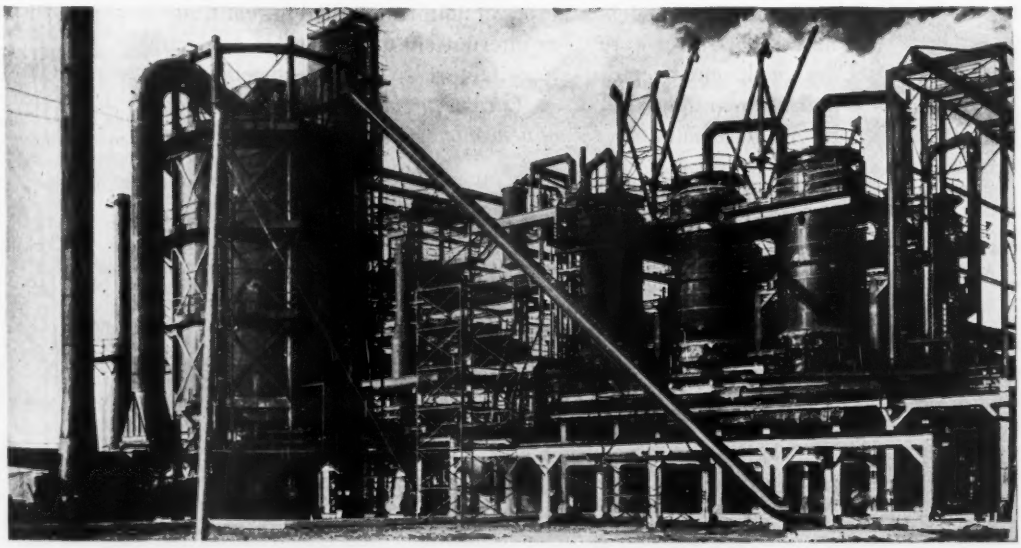
First Woman Wins Suggestion Award. The March suggestion contest at McDonnell Aircraft Corporation resulted in prizes for these two ideas: (1) a stand to hold shear webs during the forming of their flanges; (2) a procedure in the burring operation on cowl skins by which the panels used to hold the skins are reworked to increase production. *McDonnell Bulletin*, May 26, 1944.

Machine Shop Employees Put Ideas to Work. Suggestions from Fairchild employees that won awards include the following: (1) A locking slot for the copilot's pedals and rudder control, which can be cut on a machine. (2) Standardization of the size of the slot on spar rear fittings, enabling the operator to mill the slot with one operation. *The Faircrafters*, May 26, 1944.

Blue Dye Idea Wins Suggestion Award. Employees' ideas as follows won awards: (1) A blue dye spray for templates to replace numerous coats of lacquer, eliminating time used in painting and repainting the templates. The dye does not chip or peel and increases the useful life of the template, saving $2^1/_2$ man-hours per day. (2) Addition of an automatic air-valve mechanism to facilitate the blowing away of drill chips by compressed air. Other suggestions made are estimated to result in a saving of 1,677 man-hours per year. *Convair News*, May 5, 1944.

To Fly 1000 BOMBERS...

OUR BOYS can fly these four-engined bombers faster, higher and carry more bombs because they use 100-Octane Aviation Gasoline, the most powerful gasoline in the world.



IN NEWLY COMPLETED, modern refinery units Sinclair produces each day enough 100-Octane gasoline to fly 1000 four-engined bombers on a bombing mission. Today, all of Sinclair's aviation gasoline goes to war. After the war this fine fuel will be available for commercial and private planes.

BUY MORE WAR BONDS AND STAMPS

SINCLAIR

Feathering a wounded Fortress . . .

Roaring over the blazing target of Schweinfurt . . . ploughing across flower beds of flak . . . and skies deadly with missiles of Messerschmidts—a Flying Fortress is sieved with shells. Bomb bays empty . . . wings riddled, gaping holes in tail and belly, two engines out, the valiant warrior limps home—leaving behind a flaming hell on earth.

A few seconds after each engine cut out, the co-pilot feathered its prop. The two feathered propellers act as powerful brakes, stop engine rotation, prevent vibration which might tear the wounded engines loose. And feathering also stops "windmilling", reduces drag, restores maneuverability . . . enables the crippled Fortress to get home.

The motors which feather many of the Hamilton Standard Hydromatic propellers on the Fortresses were designed, engineered, and are manufactured by Air Associates.

Extending only 6⅛" back from the mounting face . . . with an armature stacking of 1⅛"—*the mere width of a wine glass*—this motor weighing only 12 pounds combines *high horsepower* output with low weight—delivers 3 h.p. at 2,300 r.p.m. High starting torque overcomes high inertia. Glass insulation of coils increases ruggedness. Magnesium alloy castings reduce weight to a minimum. Total enclosure protects it against the elements. The motor is designed and tested for intermittent operation at temperatures of from −65° F to +160° F, and for altitudes as high as 35,000 feet.

Small, light, rugged, efficient, made of the best materials and hand assembled with the highest standards of craftsmanship, model EE-125 is only one of many precision-built geared and direct drive types of motors designed for continuous or intermittent duty that Air Associates manufactures to Air Corps specifications.

• *Current production permits acceptance of new orders on motors for early delivery.*

• AIR ASSOCIATES, INC.

TETERBORO, N. J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

Plant Suggestions Win 17 Workers $600 in Awards. A suggestion for improving the B-24 master spar jigs and an electrical unit to assist in an adjustment that must be made on the B-24 assembly line won two major prizes for employees' suggestions at North American Aviation. *Take-Off*, May 26, 1944.

Suggestion Increase Continues from All Buildings and Shifts. Production economies were effected at the Curtiss-Wright St. Louis plant as the result of these suggestions submitted by employees: (1) A procedure for forming the skin on the bottom trailing edge of the outer panel; (2) the relocation of the dial on the water-test machine and the changing of the valve for easier operation; (3) the placing of slotted wood strips over edges of skins when operations are performed through the flap-closure holes on the trailing edge of the airplane's center panel; (4) a method of overcoming trouble experienced in bucking rivets under the TT clip on the lower aft fuselage assembly. *The Curtiss-Wright-er*, May 26, 1944.

Production Certificates Presented War Workers. Certificates of merit were presented to five workers at Goodyear Aircraft Corporation's Arizona plant in recognition of the following ideas: (1) A special type of hand cart for use by dispatchers, which is easy to manipulate and can carry heavy loads; (2) A winding device for pigtailing cable wires on the airplane. Requiring less help, this device is also reported to speed up work. (3) The combination of piercing operations in a conventional drop-hammer die by placing the locating pin in the bottom of the starter die. (4) The use of kerosene as a solvent to remove masking paper from Plexiglas. (5) An improved method of wiring a motor generator, which saves material and time. (6) The application of liquid soap to a metal plate placed under the airplane's wheels, which eliminates the use of wing jacks when turning the wheels. *The Wingfoot Clan*, May 11, 1944.

Substitution of Air for Coolant Is This Month's Top Suggestion. Four of the current prize-winning suggestions at Pratt & Whitney are the following: (1) Substitution of air-cooling for the oil coolant when drilling the crankcase rear section of aircraft engines. (2) Device for eliminating vibration in the grinding of low-velocity clutch cones. (3) A stop device for the indicator holders of Norton O.D. grinders. (4) A rearrangement of operations in machining engine crankcase power sections, which saves both setup and machining time and makes for greater accuracy. *The Wasp Nest*, May, 1944.

Adopted Ideas Continue to Up Production. The following production innovations have been adopted by the St. Louis plant of Curtiss-Wright: (1) change in the material and procedure of the light-guard assembly; (2) coded sketches to show which area of parts need to be chrome-plated; (3) a two-point torch for flame-hardening certain adapters and similar parts; (4) a tool for inserting the sleeve in the nut before assembling on the tubing prior to the flaring operation; (5) method of tightening clamps on jigs. *Curtiss Wright-er*, May 5, 1944.

Suggestions Award Winners for Month of April Named. The following suggestions won awards at North American Aviation: (1) system that eliminates hand burring of certain parts; (2) use of electric cutters for cutting skyfelt; (3) method of preheating carbon-pile-type voltage regulators. *Skywriter*, May 12, 1944.

$69 in Stamps Paid Suggestors. The suggestion winning the largest weekly award at the Nashville Division of Consolidated Vultee Aircraft for the week of May 12 was for an improved method of drilling holes for an airplane-engine mount. *The Consolidated Vultee Volunteer*, May 12, 1944.

For One Idea—Two Awards. Two awards have been presented for the following idea: replacing the metal bushings and shafts on engine cowl-flap mechanisms with a standard rubber-hose connection. *The Skyliner*, April, 1944.

WPD Suggestion Awards Granted. The following innovations at Northrop Aircraft, Inc., won awards for the people who suggested them: (1) an improved method for moving inner wing sections out of the master jigs; (2) new steel heat-treating procedures; (3) a new technique in the welding of magnesium alloys; (4) improved fabrication sequence on bomber parts; (5) a retainer shield on the lower bevel gear drive for the Van Norman milling machines; (6) "one-hit shrink block" for a hydropress; (7) a clamping device to assist in perfecting tooling; (8) a universal hole reamer. *The Northrop News*, May 10, 1944.

Employes Take in the Money for Suggestions. Production short cuts that have been instituted at the Burlington plant of Fairchild Aircraft in accordance with employees' suggestions are: (1) riveting tank cover attachment together and making it as one piece, using male and female die; (2) attachment for the Ames Comparator, which checks concentricity of F.S. bushings and at the same time checks the inside diameter for size; (3) boring 3-in.-diameter holes $^1/_2$-in. deep in the top section of the standard die shoes for knockout plates; (4) device for clamping pressure on the reinforcement rings that go on the inspection holes of stabilizer skins; (5) jig for checking parts after welding; (6) painting starting lines on Duramold dies and mandrels to insure uniform work; (7) wrench for loosening and tightening bolts on stabilizer jigs. *The Faircrafters*, May 12, 1944.

(*Continued on page 181*)

I.A.S. National Meetings Schedule—1944–1945

SUMMER ANNUAL MEETING	**July 27–28, 1944**	LOS ANGELES, CALIFORNIA
AIR TRANSPORT MEETING	**September 22, 1944**	WASHINGTON, D.C.
FALL MEETING	**November 9–10, 1944**	DAYTON, OHIO
WRIGHT BROTHERS LECTURE	**December 17, 1944**	WASHINGTON, D.C.
THIRTEENTH ANNUAL MEETING	**January, 1945**	NEW YORK
SPRING MEETING	**April, 1945**	DETROIT, MICHIGAN

FENN PLANTS are set for ACTION

HARTFORD PLANT

NEW BRITAIN PLANT

Building War Products Today
Peace Time Products Tomorrow

Fenn Plants, wholly engaged in war production today, will, when peace comes, continue building special machinery, in which they have majored for three generations. If you are thinking of building new machines or remodeling old ones, it's time to plan Now.

Fenn Aircraft
BUILT PARTS FOR FAMOUS PLANES

Fenn Plants are delivering precision parts and sub-assemblies for planes, artillery and other vital war equipment to practically every industrial center.

FENN FOR SPECIAL MACHINERY

Fenn designers and engineers have solved many knotty problems in machine design, resulting in efficient, profitable production. Fenn has the men and experience to handle almost any machine design job. Consultation is invited and involves no obligation.

THE FENN MANUFACTURING COMPANY
HARTFORD • CONNECTICUT

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to Corporate Members of the

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Listed below are the leading aeronautical and industrial companies that make possible the publication of the *Journal of the Aeronautical Sciences*.

They enable the Institute to publish scientific and technical papers in the *Journal* and to devote its pages exclusively to editorial material.

Dues from individual members which would normally be used to publish this scientific and engineering quarterly are thus released for additional services to the profession and industry.

Advertising defrays the cost of publishing the *Aeronautical Engineering Review* and the *Aeronautical Engineering Catalog*.

These publications provide a comprehensive technical information service for the benefit of the aircraft and related industries.

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AIRCRAFT INDUSTRIES COMPANY
AIRCRAFT RADIO CORPORATION
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  AIRESEARCH MANUFACTURING COMPANY OF ARIZONA, INC.
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ALUMINUM COMPANY OF AMERICA
AMERICAN AIRLINES, INC.
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BALLARD AIRCRAFT COMPANY, INC.
BAUSCH & LOMB OPTICAL COMPANY
BEECH AIRCRAFT CORPORATION
THE BG CORPORATION
BELL AIRCRAFT CORPORATION
BENDIX AVIATION CORPORATION
  BENDIX PRODUCTS DIVISION
  BENDIX RADIO CORPORATION
  ECLIPSE-PIONEER DIVISION
  EXPORT DIVISION
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  PACIFIC DIVISION
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BOEING SCHOOL OF AERONAUTICS
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THE CLEVELAND GRAPHITE BRONZE COMPANY
THE CLEVELAND PNEUMATIC TOOL COMPANY
  AUTOMOTIVE-AIRCRAFT DIVISION
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YOUNG RADIATOR COMPANY

POINTERS ON PLANES . . . . . *No. 6 of a Series*

Formula for "Forwarder"

The famous Fairchild "Forwarder", designed in 1932, has been constantly revised and improved . . . and is now called the UC-61K.

Ranked before the war among the most popular four place planes—and renowned now, as always, for its stability, it is performing a vital function in many theatres of war.

The engine section has been completely changed, with the 200 hp. Ranger inverted inline replacing the 165 hp. radial. The new "K" model has a longer, more streamlined nose, which makes it look larger and, in combination with a high wing design, affords better visibility both in the air and on the ground.

The use of wide landing gear, placed well forward, and the aid of wing flaps, makes possible short landings and take offs in small, rough fields.

These and many other improvements, such as ball bearings in all control joints which reduce wear, increase maneuverability, and add to the life of the plane, contribute to the growing popularity of the UC-61K.

It may be used, for example, in advance reconnaissance of enemy gun positions during invasions. And as a utility cargo carrier where medical supplies, ammunition, or parts must be rushed to the front lines. It speeds pilots and high-ranking officials to points where they are most needed.

In the "Forwarder" our armed forces have a plane which, since it first came from the drawing boards, has always been ahead of the times, the embodiment of the Fairchild "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland....Burlington, North Carolina

From the Industry

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

New Allison Liquid-Cooled 24-Cylinder Engine

Described as the most powerful aircraft engine developed up to the present, this new Allison liquid-cooled engine has maximum ratings approximating 3,000 hp. When it was tested at Wright Field in June, 1943, it was rated the most powerful engine ever to pass those tests; since then its power has been increased. Installation of the new engine in fighters still on the secret list is expected to give those U.S. fighting planes the greatest striking power of any aircraft anywhere.

The new Allison, which is designated as the V-3420 series, is a 24-cylinder, liquid-cooled engine. It has exactly twice the piston displacement of the present standard Allison 12-cylinder engine.

Through simplified designing 97 per cent of the piece parts are interchangeable with those of the present Allison. For this reason, spares and replacements are now available in Air Forces depots of the United Nations all over the world. No additional training will be required for men now stationed in any of the principal theaters of war whose task it is to service Allison-powered fighters.

The cylinder arrangement of the new engine is in the shape of a "W," formed by four banks of six cylinders each. There is little increase in frontal area compared with the present engine despite the horsepower increase.

Numerous uses for the new engine are envisioned, since it not only can be installed in a conventional pursuit-plane nacelle, but it has been designed specifically for "buried" installation, indicating the ultimate elimination of powerplant drag in airplanes. The two-crankshaft arrangement of the V-3420 contributes to these possibilities. This basic design is stated to have removed the causes of engine-torque reaction. Allison Division of General Motors Corporation.

Aircraft Materials Sales Center

The American Aviation Mart opened on the 17th floor of the American Furniture Mart Building, Chicago, on June 5, for the sale of surplus materials and equipment no longer needed by the aircraft industry. It is expected that the display center will serve later as a distributing point for parts, supplies, and airplanes.

Samples of the various items to be sold will be on display and goods will be shipped from warehouse centers elsewhere. Purchases may be made by manufacturers in lots of $500 up to accommodate small producers, but all sales will be subject to approval by government agencies including the Army, Navy, and War Production Board.

Among the items that will go on sale will be brass, copper, bronze, steel, aluminum, rivets, hardware, electrical equipment, tools and abrasives, and a miscellaneous grouping of paint, oil, dope, felts, cloth, welding rods, tape, asbestos, leather, and rubber. The first concern to lease space in the mart was Curtiss-Wright Corporation, and other firms are expected to join in the showing at an early date. American Aviation Mart, Chicago.

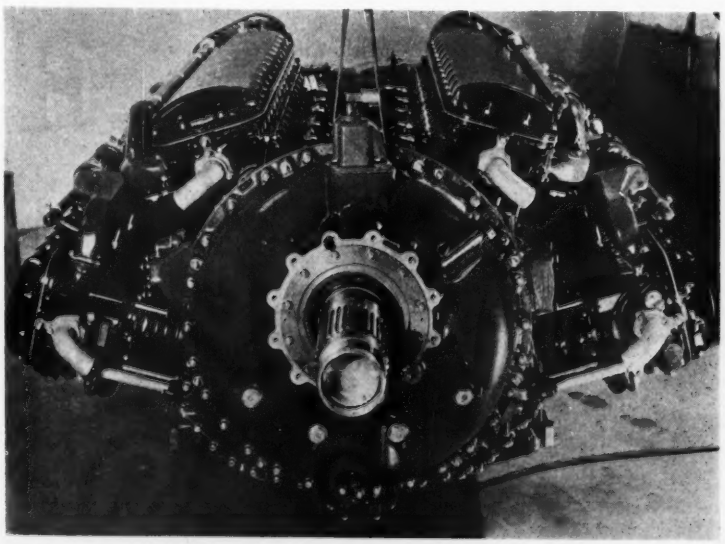
First Indoor Helicopter Flight in America

Before an audience including officers, members, and cadets of the Civil Air Patrol, the new Bell helicopter was flown in a specially arranged flight demonstration inside the 65th Regiment Armory in Buffalo, New York. The flight demonstration, arranged at the request of CAP officials, was staged to show the stability and precision control of the craft and its ability to take off, maneuver, and land in restricted areas.

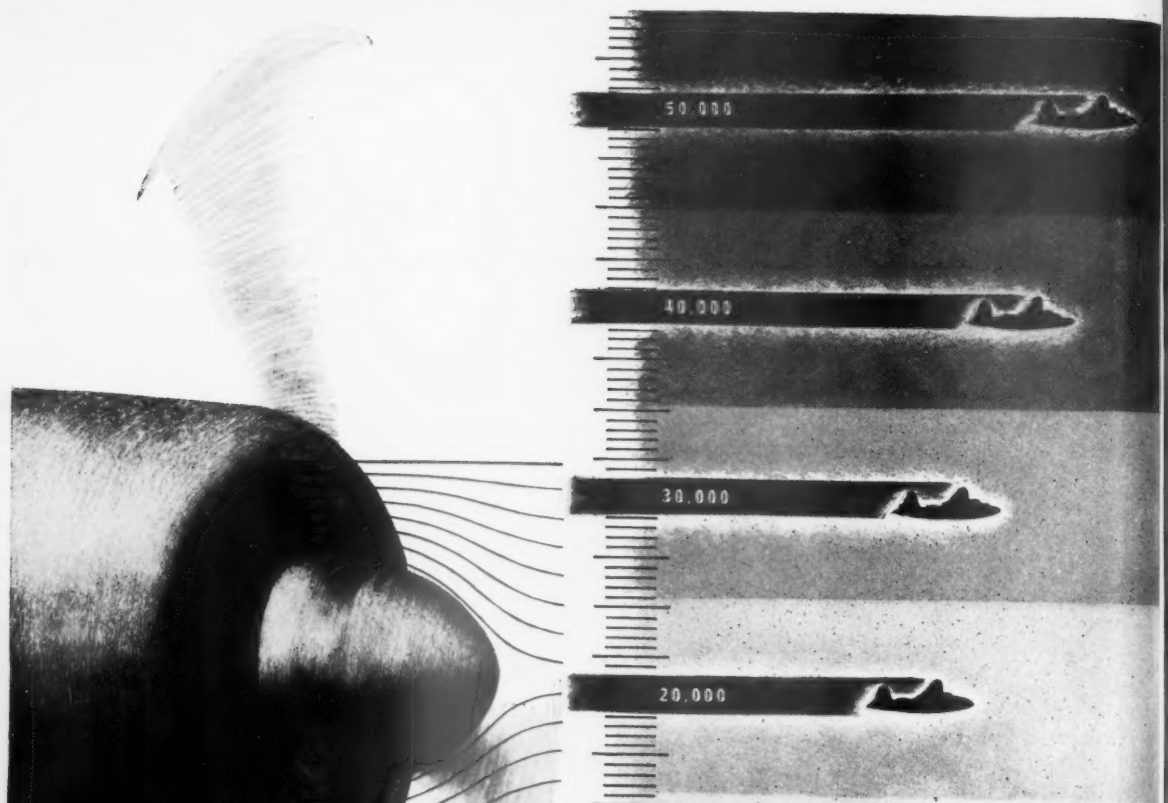
This is believed to be the first time that a helicopter has been flown indoors in this country. The only previously known flight of a helicopter indoors is reported to have been made in 1938, when a series of demonstrations of the rotary-wing craft designed by Dr. Hendrick Focke was staged in a hall in Berlin, Germany. Bell Aircraft Corporation.

Cargo Plane of Stainless Steel

The Conestoga cargo airplane utilizes welded stainless steel instead of riveted aluminum-alloy sheets. Designed by a staff of engineers directed by Michael Watter, it was developed under sponsorship of the Navy Department, Bureau of Aeronautics, and is being built under a Navy Department contract. The plane was designed specifically to be a cargo carrier. The engineers centered their efforts on the problem of designing



The new Allison 3,000-hp., liquid-cooled, 24-cylinder engine.



THIS laminar flow profile fan with exit vanes is designed to cool an aircraft engine by delivering the same required weight of air at various altitudes. DeBothezat's modern aero-dynamic laboratories are ably staffed with skilled technicians experienced in solving difficult engine cooling problems.

Sea level
COOLING
at all altitudes

De Bothezat Fan Division
American Machine and Metals, Inc.
East Moline, Illinois

a "flying boxcar," which could carry freight economically on flights of moderate length and also be capable of loading and unloading cargo with ease and speed.

The plane is a two-engine transport, 68 ft. long, with a wing spread of 100 ft., and is capable of transporting 10,400 lbs. of cargo over a range of 650 miles. Its two 14-cylinder, radial air-cooled engines deliver 1,200 hp. each for take off and have a normal rating of 1,050 hp. It is reported to have demonstrated its ability in normal operation to lift 10,400 lbs. of pay load from the landing strip in a run of only 920 ft.

One of the plane's distinguishing characteristics is a ramp to facilitate loading and discharge. The cargo compartment is 25 ft. long, 8 ft. wide, and 8 ft. high and is unobstructed by structural members. The plane is also equipped with a large cargo hatch in the underbody, which may be lowered to form a ramp to the surface of the landing field or to a loading platform level with the platform of a truck. Back of it are two large clearance doors that may be lifted out of the way to provide the necessary headroom to utilize the 8-ft.-square cross section of the cargo compartment.

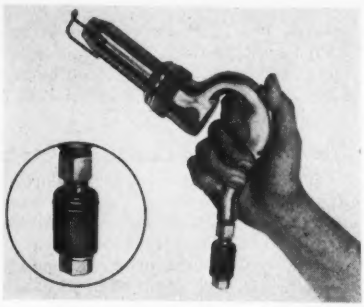
The upward sweep of the afterbody of the plane provides a large clearance below the fuselage and back of the ramp to allow trucks to be moved close to the fuselage so as to pick up or discharge shipments. Provision is made for handling cargo with the aid of a specially designed hoist fitted above the loading ramp, as well as a manually operated winch mounted on the forward end of the cargo compartment. These permit the loading of large, heavy pieces of freight or machinery. Both an ambulance and a jeep can be rolled into the cargo space at once and still leave a large space for stowage of other cargo. One of the advanced developments for cargo handling in the design of the plane is that all loading is done on the level. On the ground and in level flight the floor of the cargo compartment remains horizontal, obviating the necessity for hauling freight up an inclined floor before stowage. This is facilitated by the use of a tricycle landing gear.

The unusually large cargo space is made possible through the design for the attachment of the wing to the fuselage. The wing structure does not pass through the fuselage in conventional fashion; instead, the designers, through a novel arrangement of the fuselage, were able to attach the wings to five special side frames joined across the body by shallow but rigid transverse members, thus providing headroom of 8 ft.

Although primarily a cargo carrier, the plane can be converted to troop transport or to aerial-ambulance use. Provision is made for installation of 24 seats and 24 stretchers for possible use in the evacuation of wounded from battle areas to base hospitals behind the lines. Doors in opposite sides of the fuselage permit launching of paratroops from both sides simultaneously, and provision is also made for the discharge of cargo or paratroop supplies and equipment by parachute through the opened clearance doors in the aft portion of the body.

The plane requires a crew of two, a pilot and a copilot, whose quarters are in a full-height operating compartment in the nose of the plane. Dual controls are installed, as well as remote-control radio and facilities for instrument landings and take-offs.

The total weight of plane and load is 33,800 lbs., of which 10,400 lbs. represents the weight of cargo. With a full load, including equipment, fuel, and the crew, the plane at a cruising speed of 165 m.p.h. will have a range of better than 600 miles. Each engine develops about 710 hp. at cruising speed. The maximum range with available fuel tankage will be about 1,700 miles. This can be increased up to 3,500 miles with auxiliary fuel tanks. Edward G. Budd Manufacturing Company, Philadelphia.



The Burklyn adjustable flow regulator, designed for a maximum pressure of 1,500 lbs.

Adjustable Flow Regulator

The Adjustable Flow Regulator is a new type of control valve, for use in connection with pneumatic tools and other devices, for regulating the volume of air or fluid flowing from supply line to tool, or for use as a shut-off valve.

Rotation of the outside knurled sleeve provides flow control or regulation. Clockwise rotation opens the valve and counter-clockwise rotation closes it. Eight adjustment points are provided for one revolution of the regulating sleeve. Each adjustment increases or decreases the opening 0.004 in. Use of the device makes fine working-speed adjustments possible on 1,500 to 13,000 r.p.m. air drills, for example, or on rivet hammers. The regulator may also be attached directly to a supply line carrying air, water, oil, or gas, and will hold up to 1,500 lbs. pressure without leaking. There are only three major parts to the regulator and no projecting knobs to catch or break off. Weight is about 5 oz. Burklyn Company, Los Angeles.

Optical Flats and Monochromatic Light

Greater wearability and lower coefficient of expansion are features claimed for the new DoAll optical flats. These are made from fused Brazilian quartz, which has a hardness of seven on the Moh scale as compared with six for optical-grade glass, as well as a lower coefficient of expansion than optical-grade glass. They are intended for the accurate inspection of master flats, flat surfaces of gauges, machine parts, anvils of micrometers, comparators, and steel bars.

Six sizes, in diameters of 2 in., 3 in., 4 in., 5 in., 6 in., and 10 in., are available, each flat being packaged in a hardwood case. They are available in two grades of accuracy; one-millionth accuracy for laboratory gauge-block and instrument inspection, and two-millionths accuracy for checking instruments and fine tools. Their polished surfaces and accurate measuring faces provide a true surface with which to measure the flatness or the dimensions of precision parts. They use light waves from a monochromatic light.

For such a monochromatic light having large adjustable capacity as well as compactness, the manufacturer offers the DoAll Monolight using helium light rays. Helium is used because it is obtainable in a highly purified form, has uniform wave length, and a distinguishable yellow color. The light is high in intensity; this concentrates the light on a smaller area, giving greater illumination for distinguishing the light-wave unit known as the "fringe" or interference band. The rays from this light, when observed through the optical flats, produce interference bands of 11.6 micro-inches. These interference bands are used to measure flatness, height, and parallelism. It is possible to read accurately, within millionths of an inch, variations in the size and flatness of parts when viewed through the combination of optical flat and monolight. Dimensions are: maximum height, lamp to table, 12 in.; minimum height, lamp to table, $8\frac{1}{2}$ in.; projection head tilts 90° up and 21° down; rotates 360°. The projection head is removable for inspection in hand. Net weight is 12 lbs., and the operating current is 110 volts, 60-cycle, single phase. Continental Machines, Inc., Minneapolis.

Three-Ply Laminated Plastic Sheeting

Three-ply laminated plastic sheeting is designed to give added protection to airmen flying in pressurized high-altitude planes. The new sheeting is claimed to reduce the possibilities of disintegration of clear plastic canopies when pierced by bullets or flak while flying at high speeds under pressurized conditions.

Called laminated Lucite-Butacite, it consists of a single layer of Butacite polyvinyl butyral resin between two layers of Lucite methyl methacrylate resin. An important part of the problem was the development of a special adhesive to accomplish the lamination.

Tests conducted by both the Army and the Navy show that, under certain conditions, the new laminate has a self-sealing tendency whereby holes created by bullet penetration close up almost completely because of the rubber-like nature of the Butacite interlayer sheeting. At ordinary temperatures, even under pressure, the hole left by the bullet is small and the amount of shattering is not excessive. In most cases the hole

may be promptly sealed with a patch, permitting maintenance of essential air pressure within the cabin.

The weight per square foot of the new laminate is stated to be less than that of equivalent thicknesses of solid acrylics now being used. It is equally transparent and is readily adaptable to a variety of mounting techniques, permitting design of enclosures so that obstructing metal parts and ribs can be eliminated from the lines of vision. For most applications, procedures used in forming solid acrylic sheeting have been adopted.

It is expected that aircraft operating at lower altitudes will also benefit from the development because of the added safeguard against the shattering of enclosures in collisions with birds and against rupture from the impact of ice flying back after forming on the propeller. E. I. du Pont de Nemours & Company (Inc.).

Whitworth Thread Comparator Charts

British Standard Whitworth Thread, engineers' transparency (glass) charts for optical projectors and comparators, are offered in two distinct sets. One set is for close fit and the other for medium fit. The sets are composed of 21 charts each and cover pitches from 40 to 3.5, inclusive.

Sizes of charts and magnifications match the American National Form Screw-Thread Comparator Charts. They are available either as complete sets or in selections of individual charts. These charts are accommodated by the chart-holding fixtures, adapters, and filing cabinets regularly supplied. Engineers Specialties Division of Universal Engraving & Colorplate Company, Inc., Buffalo.

Carriage-Mounted Drills

High-speed carriage drills for production drilling of aluminum-alloy spars, wing panels, and other long assemblies are furnished as complete units, ready for installation on rails fastened to an assembly fixture. The addition of rails is all that is necessary to make an existing assembly fixture suitable for machine drilling.

A variety of carriage mountings, both horizontal and vertical, is available. For curved surfaces, such as wing panels, a carriage unit is available which is automatically controlled by a cam mechanism, keeping the drill perpendicular to the contour of the work as the carriage travels on the straight track.

The drill feed, drill depth, and return stroke are automatic. After the drill unit is manually located in the jig hole and the thumb button is depressed the cycle proceeds automatically. When the predetermined stop is reached the drill returns to the starting position. The drill spindle is belt-driven by a standard $^1/_2$-hp. motor. Spindle speeds up to 10,000 r.p.m. are available. Holes up to $^3/_8$-in. diameter can be drilled. These units were designed by Paragon Research, Inc., for the manufacturer. Farnham Manufacturing Company, Buffalo.

Autotransformers for Aircraft

Two small-size autotransformers have been especially designed to furnish proper a.c. voltage for operation of 400-cycle aircraft instruments such as the remote-indicating compass. The 6-volt-amp. unit weighs 2 oz. and the 12-volt-amp. unit weighs 3 oz. Dimensions of the units are approximately $1^3/_4$ in. by $1^1/_4$ in. by $1^1/_{16}$ in., and they both operate over a frequency range of from 380 to 420 cycles.

These autotransformers can be applied on planes that have a 110–120 volt, a.c. power source available, eliminating the need for additional inverters to supply, from the d.c. source, the correct a.c. voltage for operation of these instruments.

With sufficient ventilation, the autotransformers will operate efficiently at any altitude. The core and coil units are impregnated with moisture- and heat-resistant Glyptal clear varnish. All exposed solder joints are coated with G-E Red Glyptal to prevent corrosion, and the mounting clamps and terminals are also suitably protected against corrosion. While rated at 120-volt input, they are suitable for operation over a voltage range from 110 to 130 volts. General Electric Company.

A Motor Problem?

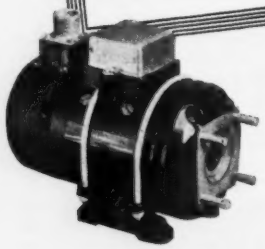
IN DEVELOPING THAT NEW PRODUCT

If you want reliable motor performance make sure—

1. That you consider the motor in the early stages of product development.
2. That the motor is specially designed for your particular application.
3. That it will be rigidly tested under actual operating conditions.
4. That the motor manufacturer will maintain the high standards of workmanship represented in the sample submitted for testing.

Our many years' experience covering all types of fractional horsepower motors is available to your engineering department.

THE BLACK & DECKER ELECTRIC CO.
KENT, OHIO



THOROUGH ENGINEERING is the basic factor behind the successful operation of this hydraulic pump motor and many other fractional horsepower motors we have designed for all types of equipment.

Black & Decker
FRACTIONAL HORSEPOWER SPECIAL APPLICATION MOTORS

5 10 15 20

Channel crossing time... 2½ minutes flat!

It's 21 miles from the white cliffs of Dover to the beach at Calais. Yet jet propelled fighter planes of types currently under development for the United Nations, can cover that distance in about 2½ minutes flat.

For jet propelled planes are capable of speeds *in excess of 500 miles per hour*—more than ¼ as fast as a machine gun bullet.

In addition to its great speed in level flight and its excellent performance in rate of climb, the jet propelled plane possesses other advantages which its further development may be expected to demonstrate.

At McDonnell—after Victory—we expect to further the progress of jet propelled aircraft through comprehensive research and development work. *Right now,* our all-important job is making planes, parts and plastics for war... and a quicker Victory.

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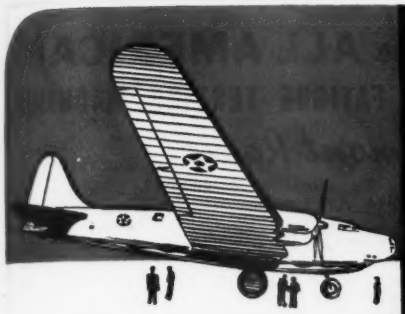
Manufacturers of PLANES · PARTS · PLASTICS ★ SAINT LOUIS - MEMPHIS ★

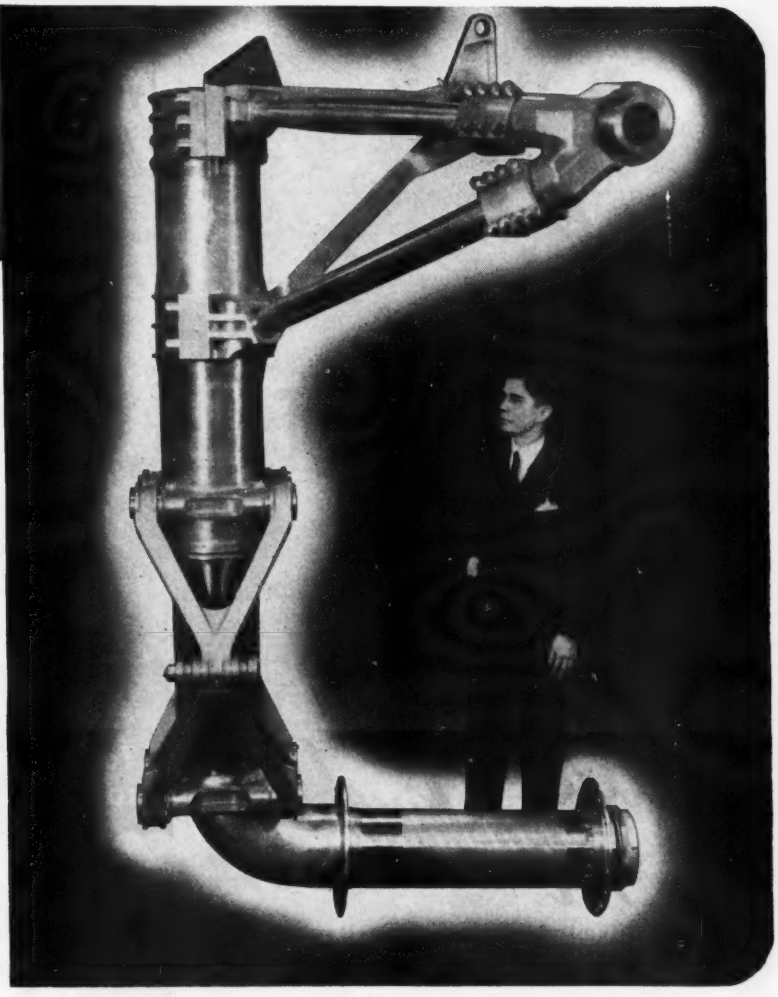
New Hydraulic Wiper Motor

WEIGHS 1 POUND, SMALL, POWERFUL, EASY TO INSTALL

A complete motive unit, easily tied into the airplane hydraulic system, this motor produces ample power for the operation of windshield wiper blades across flat, curved or compound curved glasses. The motor has high torque, permitting a blade speed up to 400 strokes per minute during flight. Contributing to the efficient design of the new unit is our experience, gained from pioneering and producing the wipers now used by the U. S. airlines and air forces of the Army and Navy.

The Marquette
METAL PRODUCTS COMPANY
Cleveland 10, Ohio





STEEL KNEES *for an* 80-TON WARBIRD

When an 80-ton battleship of the skies "sits down" hard on a concrete runway at 100 miles an hour, something must cushion the impact.

On the famous B-19 bomber, huge pneumatic-hydraulic aerols, like that above, help absorb landing shock—much as your knees helped soften the jolt of your boyhood back fence jumps.

The two mainlegs and nose strut weigh less than 4,000 pounds, but they were machined down from 53,000 pounds of rough forgings.

And there is an important reason for the use of Republic Electric Furnace Steel.

Costly man- and machine-hours were required to finish those close-fitting parts to exact tolerances. Had an imperfection in the steel caused rejection at final inspection, much labor and material would have been wasted.

But Republic Electric Furnace Steels provide extra insurance against such losses—because they are as CLEAN and SOUND as the most expert furnace practice and decades of experience can make them.

These fine steels are *consistently* UNIFORM—in physical, chemical, workability, hardenability values. They are homogeneous—free from variables that upset established practices. With them you can derive full benefits from mass production. And you can predetermine product qualities with exactness—because Republic Electric Furnace Steels are "targeted" by the precise control of electric furnace melting to hit the most rigid specification marks—accurately, repeatedly.

Republic's unequalled experience as the leader in this field of steel making and its increased capacity can help *YOU.* Ask us for further details.

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ELECTRIC FURNACE STEELS

"QUALITY" steels . . . alloy . . . stainless

an element of Victory

OH 38

Easily Machinable

An Aluminum Alloy—Non-Heat Treated. The perfected metal that surpasses all others for a wide variety of machining operations. Non-corrosive—Easy on machine tools—Holds threads without stripping. Its light weight reduces table and machine loads and increases tooling accuracy. 5 years of proven superiority in hundreds of plants. OH 38 is an exclusive Hedstrom product.

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for Belmont Radio!

THE Model 100HA All American Vibration Fatigue Testing Machine shown is the latest addition to Belmont Radio's modern testing laboratories. This unit subjects parts up to 100 lbs. each in weight to simulated "in service" shakedown tests. Frequencies from 10 to 55 cycles per second (600 to 3,300 vibrations per minute) and back to 10 c.p.s., continuously and uniformly, are controlled automatically; complete cycle requiring one minute. Can also be manually controlled.
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Auxiliary Tempering Attachment for Synchronous Spot-Welding Controls

A tempering attachment is available for use with G-E synchronous spot-welding controls that incorporate the phase-shift method of heat control. The new auxiliary control is particularly suitable for use in the spot-welding of air-hardenable steels, since it permits tempering the weld while the work is still in the machine, reducing hardness and increasing ductility.

The attachment consists of a heat-control and time-control adjuster for tempering and relays that automatically transfer the additional heat-and-time adjustment from the spot-welding control with which the attachment is being used.

The new attachment is enclosed in a metal case designed for wall mounting. The calibrated adjustment dials are mounted on the hinged door of the case, together with an "on-off" switch for preventing the relays from being energized when ordinary spot or pulsation welding is being done. General Electric Company.

Air Circuit Breaker for Aircraft-Generator Protection

Type XRP, a new d.c., reverse-current, air circuit breaker, is designed especially for aircraft use and built to satisfy Army Air Forces specifications. It is rated 400 amp., 30 volts, with a reverse-current trip setting of 300 amp. and interrupting rating of 8,000 amp. at any altitude from sea level to 50,000 ft. The breaker is connected in the generator circuit between the generator relay and the positive bus, one being used in the circuit of each generator.

The standard breaker has a reverse-current trip setting of 300 amp., which is suitable for use with standard 28.5-volt aircraft generators of either 200- or 300-amp. rating. The current-interrupting capacity is sufficient for use on systems employing up to six 300-amp. generators and up to three storage batteries. Small values of reverse current occur in normal operation when, for example, the generator speed is reduced to a point at which its generated voltage is lower than the bus voltage. In this case, the generator relay operates to disconnect the generator from the bus. The XRP breaker does not trip because the reverse current is lower than its trip setting. When a fault occurs in the generator circuit, however, the reverse current may rise quickly to values far in excess of the interrupting ability of the generator relay. In such a case, the air circuit breaker instantly trips and clears the fault.

Since this breaker trips on reverse current only, it eliminates false tripping on faults in other parts of the system which draw forward current. It interrupts fault currents in less than 0.015 sec. It will operate in the wide range of temperature from −65°F. to +160°F. and will withstand 95 per cent humidity at 160°F. on 48-hour test. In addition, it will meet the 200-hour salt-spray test as specified by various government agencies.

This type of breaker is not affected mechanically, in either the open or closed position, when subjected to vibrations of frequencies from 5 to 55 cycles per sec. at $^1/_{32}$-in. amplitude applied in any direction. The reverse current trip point is lowered not more than 10 per cent during the vibration. It will not trip when closed and will not close contacts from the open position when subjected to shock or a linear acceleration of $30g$ in any direction. General Electric Company.

Dust-Tight Enclosure for Housing Aircraft Control Devices

A standard dust-tight enclosure for housing combinations of aircraft control devices accommodates various G-E aircraft control relays and contactors with ratings up to and including the 100-amp. aircraft contactor. Completely gasketed to afford maximum protection against the entrance of dust, dirt, and other foreign matter, the enclosure is made of aluminum with cast aluminum end frames. A self-locking latch permits the removal of the cover of the enclosure in a vertical direction without disconnecting wires or the use of tools. This latch also has a provision for wire-locking the enclosure. In addition, the end plates are adaptable for various sizes of AN connectors or terminal posts. General Electric Company.

Rubber Bladders for Fuel Tanks of Civilian Planes

An example of wartime technology applicable to the days of peace is seen in the development of bladder-type fuel cells for noncombatant aircraft. The new development is the outcome of successful experience with bullet-sealing rubber fuel cells.

The performance of bullet-sealing fuel cells in service on fighting airplanes shows that they not only protect the fuel supply from bullets, but also reduce fuel leakage from other causes. These additional advantages can be provided for nonfighting airplanes by cells that are simpler and lighter than the combat type, being actually rubber bags or bladders designed to fit accurately into the spaces between wing supports.

In airplane fuel compartments of the "integral type," the skin of the wing is actually the outside of the fuel tank. The constant strain often causes rivets or seams to loosen—not sufficiently to weaken the wings structurally, but enough to allow leakage of fuel. Rubber cells are expected to protect a plane's fuel supply against such leaks and prevent the schedule disruptions they cause. For the present, the new bladder-type cells will be custom-built for each airplane. B. F. Goodrich Company.

Protective Plate for Power Shears

A protective plate that is easily attached to a power shear is designed to permit the operator's fingers to be placed within a fraction of an inch of the blade with complete security. With it a much more detailed operation may be carried on with safety to the operator than was possible before the installation of the guard.

The guard is constructed of $^1/_8$-in. sheet steel which hangs behind a hold-down plate and is attached to the hold-down plate by flat-headed screws. This allows the sheet to be stationary while the hold-down plate moves.

To the $^1/_8$-in. sheet are attached $^1/_{16}$-in. thick skirts that enclose the parts of the hold-down plate coming in contact with the material being sheared. The skirt assembly is adjusted to the proper height to allow for thickness of material to be cut, but it will not permit the fingers of the operator to pass through. Double protection is given, with the plate keeping the operator's fingers away from the blade and the skirts keeping the fingers free of the hold-down plate. Goodyear Aircraft Corporation.

Dip Conveyer Speeds Plane-Parts Painting

Painting of parts for aircraft has been materially speeded at the Goodyear Aircraft Corporation plant by installation of a dip conveyer, designed by the Plant Engineering Department.

The carrier is made up of two strands of chain 15 ft. apart, which are synchronized and kept at a constant speed by means of a jack shaft. Load bars made up of $2^1/_2$-in. pipes spaced at 6-ft. intervals connect the two chains. From these load bars numerous types of spreaders and hooks are suspended to get maximum loading with any type of stock or parts.

After experimentation, it was found that a conveyer speed of 24 in. per min., using a paint with a specific gravity of 1.03, was the most suitable. Speed in excess of 24 in. per min. in lighter paint results in too fast a flow, which in turn strips the pigment from the stock. The other extreme, slower speed in heavier paint, results in excessive drippings and in turn causes an uneven coating. The success of the entire unit depends upon the correct conveyer speed.

The conveyer is hung from an overhead track at a height above the floor level which is most convenient for loading and unloading. As it moves forward it drops vertically into the tank located in a pit, the top of which is at floor level. After leaving the tank the return travel is directly above and opposite the newly loaded line moving toward the tank. This plan saves space and man power because the loading and unloading stations are at the same place. Two men can easily handle the job when running at full capacity. By the correct application of spreader bars and multiple hooks, several full-sized aluminum sheets or as many as 300 small parts may be carried on a single load bar.

The dip tank, 40 in. by 16 ft., has a working depth of 56 in. Agitation is created by the use of two 9-in. screws located in troughs running the full width of the bottom of the tank. One-half of each screw is right hand and the other half left hand; consequently, the paint is thrown to the center where it is

Official U. S. Navy Photograph

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Flexibility must be provided for the plumbing in a bomber... those metallic pipes that convey fluids and oxygen. Barco Flexible Joints, (winterized for all service conditions) are performing this essential function on our planes. They compensate for shock, vibration, movement, contraction and expansion. Thirty years as the outstanding fluid conveyor connection for industrial and transportation use enabled Barco to anticipate the needs of aviation. Barco Manufacturing Company, Not Inc., Aircraft Products Division, 1826 Winnemac Avenue, Chicago 40, Ill., *In Canada*: The Holden Co., Ltd., Montreal, Canada.

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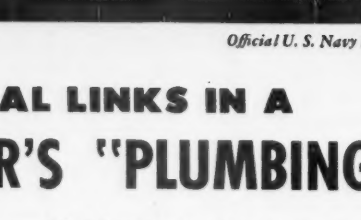
Not just a swivel joint... but a combination of swivel and ball joint with rotary motion and responsive movement through every angle.



"MOVE IN EVERY DIRECTION"

picked up by a manifold connected to a 100-gal. per min. pump. From the trough a part of the paint is discharged back into the tank through eight manifolds (four on each side) at the top of the tank. To protect the screws from any parts that may be dropped, a removable screen has been installed in the tank. The screen is raised and lowered by means of a small winch.

For fire protection an automatic carbon-dioxide system is installed within the enclosure over the dip tank. Over the top of the tank at floor level are self-closing doors held open by counterweights connected by fusible links. The fusing of any one of the links will not only close the doors but will set the carbon-dioxide system in operation and will shut off all electric power in that area. Goodyear Aircraft Corporation.

Airplane Brakes Simplified for Larger Planes

Developments in the Goodyear single-disc airplane brake have improved this new design to the point where it can be considered for far heavier planes than those previously equipped with it, according to the manufacturer. Brakes of multiple-disc construction are now being used on airplanes of all weights and classes, but the single-disc type in the past has been restricted to special-purpose light planes. It is stated that the average saving in weight over the multiple-disc type can be as much as 20 per cent.

A distinctive feature of the single-disc brake is the ease of adjustment and lining replacement. A simple exterior screw adjustment is provided on both the mechanical and hydraulic types. Brake-lining replacement on a light plane takes only a few minutes.

Increased capacity is claimed for the single-disc brake because of its rapid heat dissipation. The disc is flush with the inboard edge of the wheel rim and therefore is subjected to the full cooling effect of the air stream. Since a smaller section of the disc is under braking pressure from the shoes, a correspondingly larger surface area is available for cooling. Rapid heat dissipation in the single-disc brake also extends the life of the lining to a period beyond normal expectancy.

The Goodyear single-disc brake is made of a single steel disc with a hard chrome finish. This disc, which rotates with the wheel between two linings or shoes, is turned by a series of drive keys that are fixed on the flange. When braking pressure is applied, the brake lining makes contact with the free-floating rotating disc. This braking pressure also brings the disc into contact with the lining on the inner side. The resulting action is that of a clamp with equalized pressure operating on both sides of the rotating disc. Goodyear Tire & Rubber Company.

Round Tool Bits

Round tool bits, made either from Stellite 98M2 or Stellite Star J-Metal alloy, are furnished centerless-ground to tolerances of +0.000 and −0.002 in. on the diameter and $\pm 1/16$ in. in length. Stellite round tool bits are used on turning or boring operations or can be ground into drills or reamers. Tool bits of 98M2 are made for faster machining of steel; Star J-Metal has been used for machining cast iron, malleable iron, bronze, brass, aluminum, and some steels. Haynes Stellite Company, Kokomo, Ind.

Heat-Treating Furnaces

A new series of floor-model furnaces will consist of five basic designs. Five or more variations, with regard to the inside depth of the furnace, will be available in each of these.

The Model 16 workchamber dimensions are 12 in. wide, 8 in. high, and 18 in. deep, plus an 8 in. throat. This furnace is also available as Model 16A with the same width and height, but a depth of 24 in. In the Model 16B the width and height remain the same as in Model 16, with a depth of 36 in. The dimensions of the door in all of these models is 21 in. wide, 17 in. high, and 8 in. thick.

The furnace body is constructed of 14-gauge steel reinforced on all corners. Heating elements have totally enclosed contacts and connecting wiring is brought through the back of the furnaces into a special compartment provided for that purpose. In this series the furnaces are insulated with the Huppert principle of multi-insulation. The furnaces, in all variations, can be operated on 220 volts, single-phase or three-phase, and in many instances can be supplied for special voltages up to 440 volts, three-phase. The current consumption of the Model 16 is 9 kw.

The Series 16 furnaces have a maximum operating temperature of 1,850°F. for continuous operation and 1,950°F. for intermittent use. One number 221 Wheelco Capacitrol, one Chromel-Alumel thermocouple with protecting tube and necessary lead wire, one magnetic contactor, one fused switch box, and all electrical interconnections between these parts are standard equipment. The furnaces are complete, ready to connect to the power line when delivered. K. H. Huppert Company, Chicago.

Slide-Film Kit Sets

Slide-film kit sets have been made available as follows: Aircraft Mechanics—45 subjects, to speed up instruction in servicing and repairing planes and plane parts, wings, landing gear, brakes, flight controls, etc.; a total of 2,571 lighted teaching pictures. Aircraft Engine Mechanics—24 discussional slide-film subjects, to supplement instruction in the care, maintenance, and servicing of the model airplane engine; 1,424 lighted pictures. Aviation Metalsmiths—a total of 16 subjects, to help instruct in metalwork necessary to keep planes dependable, durable, and safe in flight; 942 lighted pictures. The Jam Handy Organization, Detroit.

Magnesium Preheat Furnace

Seven sheets of magnesium alloy, up to 4 ft. wide, 12 ft. long, and $1/4$ in. thick, can be heated to 600°F. in a new magnesium preheat furnace. It is self-contained and mounted on four ball-bearing double casters for movement to the presses where the magnesium is to be hot-formed. It provides for loading and unloading through seven double doors on either end.

The furnace is electrically heated and equipped with three blowers on one shaft. Heating elements are located in the plenum chamber in front of the blowers and extend the full furnace length. Using a Leeds & Northrup potentiometer recorder controller with special contacts, reduced heat input is provided for the "soaking" period or for low-temperature operation.

At the furnace ends, jib booms with chain hoists handle the hot tray loads. For convenience in moving, they fold back over the furnace to make the overall dimensions approximately 9 ft. high, 9 ft. wide, and 17 ft. long. With booms extended the overall length is about 38 ft. James H. Knapp Company, Los Angeles.

Control-Cable Tests

Through the use of an automatic device developed by employees in the Electrical Department of the Army Division, control cables for the B-26 Marauder and other Martin bombers are now being tested for proof load in half the time previously required. Not only does the new mechanism eliminate many manual operations but, in addition, it permits the testing of several cables simultaneously.

Under the old method the cable was inserted in the testing machine and the machine was placed in fast forward motion to take up all slack. The operator then shifted gears, reducing the speed to $1/8$ in. per min. until the proper tension was reached and the machine stopped. He next waited for the time interval required by Government specifications, reversed the machine, and finally removed the tested cable. Under this arrangement cables had to be tested one at a time.

Under the new arrangement all the operator has to do is put the cables in place, start the machine in motion, and remove the cables after testing; all other operations are handled automatically by a system of electrical relays and limit switches. Pilot lights on a special panel indicate the progress of the machine throughout the entire cycle, leaving the operator free to assemble turnbuckles and prepare additional cables for testing, an operation that was recently speeded up by the introduction of a rotary air gun to assemble and remove the turnbuckles.

The new testing setup has a load capacity of 25,000 lbs., and the number of cables that can be tested simultaneously is limited only by the proof load required for the various types of cables. These range from 288 lbs. for $1/16$-in. seven by seven stranded construction, to 17,100 lbs. for $9/16$-in. seven by 19 stranded construction. Proof load is equivalent to 60 per cent of breaking strength.

Adjustments are provided for pre-regulating the amount of tension and the

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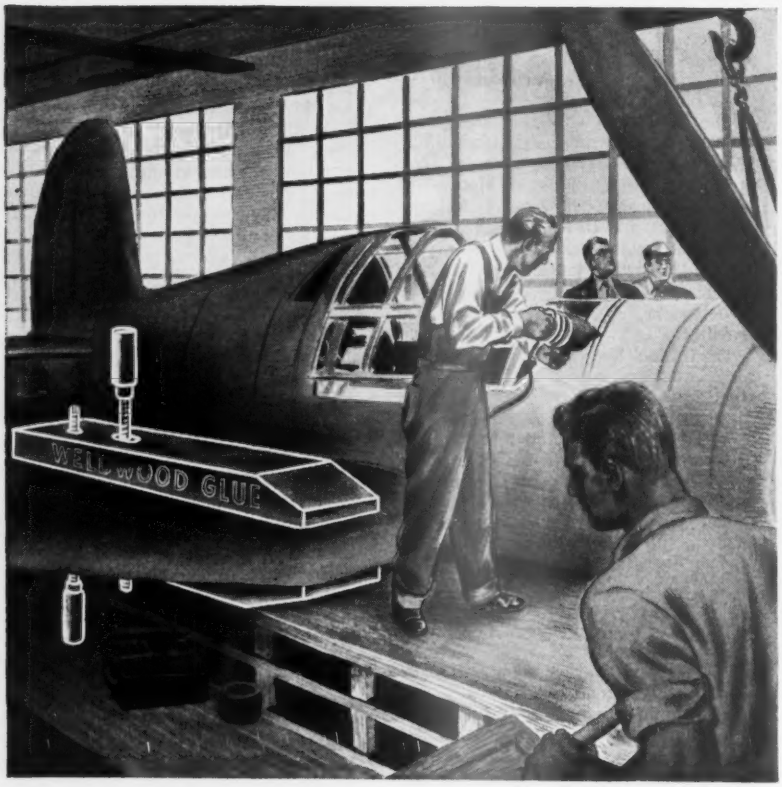

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This powerful adhesive with clamp-like tenacity . . . Weldwood Plastic Resin Glue . . . welds woods in a plastic bond that's actually stronger than the wood itself.

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time interval for which the load is sustained before the tension is slacked off. The tension measurement can be varied from the number of pounds needed for the smallest cable to 25,000 lbs., the ultimate capacity of the machine. The time interval is adjustable to meet requirements ranging from 3 sec. to 3 min. depending on the type of cable and connections being tested. The Glenn L. Martin Company.

Automatic Hardness Tester

A mechanical device for testing and automatically certifying the hardness of sheet-metal parts, known as the Martin Hardness Certifier, was invented, not primarily as a time saver, but as a means of increasing accuracy in certifying the hardness of aluminum-alloy parts. Previously these parts were tested with a hand tester and the operator had to read the results from a dial. He took approximately 20 readings per min., and at this speed there was always the possibility of error. An added disadvantage of the old method was that after the parts had been tested the operator had to take a hammer and die and stamp each part with both his personal stamp and a heat-treat stamp certifying its true hardness.

With the new hardness certifier the testing and stamping operations are combined and the entire procedure is put on an automatic basis. The machine is set for the thickness of the material and the minimum satisfactory hardness —80 in the case of ST aluminum. Parts are then fed under the indenter point of the hardness-tester unit, which moves up and down at the rate of 43 times per min. If the part meets the specified hardness, an electrically operated plunger automatically stamps it with both the inspector's and the hardness stamp. If it is too soft the plunger remains inactive and the part cannot be certified.

The hardness certifier consists of a flat-topped base member that serves as a working table on which the parts to be tested are placed, an upright support rigidly secured to the base, and an arm supported by the upright which affords a mount for the stamp mechanism. The stamping mechanism consists of a plunger and an operating solenoid. The inspector's personal stamp and that indicating the material are removably secured in the plunger.

Also mounted on the upright member is a bracket supporting the testing mechanism and the electric motor that operates it. This bracket can be raised from or lowered toward the working surface by means of a screw and crank. A block mounted on the bracket carries bearing members, which in turn support a lever on a pin. This lever is urged upward by a strong spring to hold the follower against an eccentric driven by the electric motor. The follower forces the indenter point of the hardness-testing unit, mounted on the other end of the lever, into the material under test.

Since the indenter point must be perpendicular to the material, an extension is included on the indenter pin to serve

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In the tradition of Morse and Bell and Marconi, the communications engineer carries on today.

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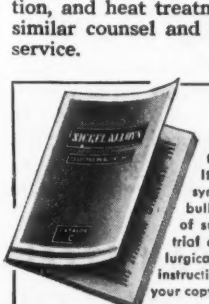
In the communications industry, as in many another, the knowledge, experience and cooperation of our staff has been at the disposal of technical men. Whatever *your* industry may be...if you want help in the selection, fabrication, and heat treatment of alloys... similar counsel and data are at your service.



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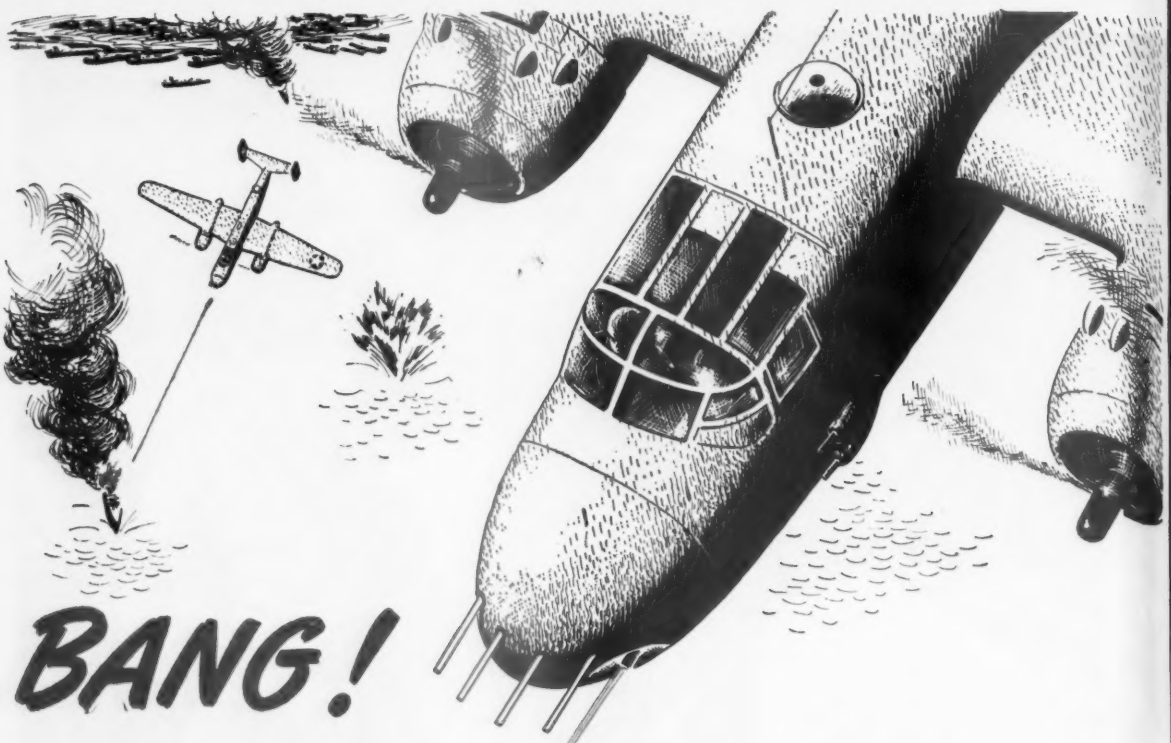

A FAMOUS FIELD GUN SPROUTED WINGS WHEN THEY FOUND A WAY TO TAME ITS KICK

INTO the air has been lifted the deadliest, heaviest gun ever mounted in an airplane. The B-25 Mitchell with a 75-mm. cannon in its chin now fires high explosive shells that can blow a light tank inside out, put an anti-aircraft battery out of action and hit a target from a distance of two miles.

The shells it fires are 26" long, weigh 20 pounds each; the projectile proper weighs 15 pounds. During tests, North American engineers have fired 3 shots in ten seconds.

How can a plane shoot such a terrific blast and yet stay in one piece? A hydro-spring recoil device, details of which are restricted, makes it possible. Actually the recoil felt in the plane is negligible. "Feels like an automobile 'coughing' on a cold morning" is the way one pilot put it.

It was our privilege to successfully furnish the springs for this flying cannon. The problem was to manufacture a spring no larger than 6" diameter, with definitely fixed height limitations, that would absorb the recoil set up by the hydraulic mechanism and re-position the gun for firing, all within the space of 1/6 of a second.

The specialized knowledge of springs that our engineers brought to this difficult job is at your service. Certainly they should be able to provide you with springs, whether used for war equipment or for peacetime products, superior both in quality and performance.

• Made of a special type steel pretempered prior to coiling to a tensile strength far in excess of the regular normal tensile strength for this size wire! Designed for a minimum number of cycles to fit the smallest possible volume, this spring is stressed far beyond normal design specifications.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

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UNITED STATES STEEL

as a height gauge. This is so constructed that when the under surface of the extension is in contact with the material the indenter point will be in the proper perpendicular position. The height gauge is adjusted by raising or lowering the bracket on which the testing mechanism is mounted.

The hardness-tester unit is easily removed from the machine to replace a broken indenter point. The switch contact can be adjusted by spacing the contacts for various hardnesses. The impact of the stamp can be regulated by adjusting the soft iron armature within the solenoid. If an indenter point breaks the machine will give a false reading but, as this is always a too-soft reading, there is no danger of the machine certifying material when it has a broken point.

The original hardness certifier was built from scrap parts gathered from all parts of the plant. Several additional machines are now being built in the Martin Tool Manufacturing Department for use in the Martin plants, and licensing arrangements have been established with the York Electric Tool Company under which that company is now producing the hardness certifier for the commercial market. The Glenn L. Martin Company.

Inserts Overcome Tap-Breakage Losses

A safety insert for tapping heads has almost completely eliminated tap breakage on jobs where this factor previously ran as high as six taps per 8-hour shift. Two jobs where the breakage factor ran particularly high were the tapping of hard, heat-treated steel gun-charger plates and bomb bay window racks. Not only was the tap breakage on these two jobs a serious factor in itself, but the broken taps would so jam into the holes being threaded that 50 per cent of the parts in which taps had broken had to be scrapped. Since tapping was the final operation on the plates and racks, the man-hours and materials lost were considerable.

The new insert is a grooved piece of Zamak, a soft alloy that replaces the steel jaws formerly used to hold the tap in place. It is identical in size and shape with the jaws it replaces except that, where the jaws are in two pieces and adjustable to take taps of various sizes, the Zamak insert is cast in one piece and each insert can be used only with the size tap for which it is designed. It can be used in any kind of tapping head.

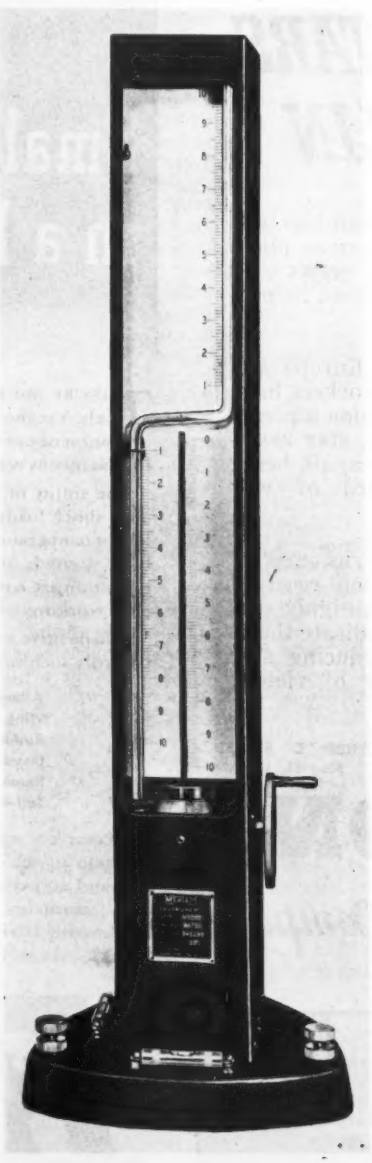
When a tap jams with the new insert, the soft metal of the insert slot wears away, permitting the tap to remain stationary while the tapping head continues to rotate. The metal is soft enough so that it gives way before sufficient force is generated to break the tap, but is hard enough to hold the tap in place during normal operations. By rotating the insert to a new position each time a tap jams, the same insert may be used approximately 15 times; after that it can be melted and recast. The Glenn L. Martin Company.

Beading Machine for Small Tubing

For beading 1/4-in. outside diameter tubing used for hydraulic, fuel, and instrument lines, a tube-beading device invented by a tool-repair man has resulted in an improved method.

Conventional beading methods utilize tools by which the bead is rolled into the metal from the inside of the tube, a difficult operation on small tubing because a shaft small enough to fit inside the tube is likely to break. The new Martin device produces the bead by squeezing. The machine consists of a pneumatic squeezer with two sets of blocks cut out for 1/4-in. tubing. One set of blocks is stationary and the other movable. In each set of blocks the 1/4-in. hole is enlarged to a cup shape at one end.

The tube to be beaded is clamped securely in place in the stationary blocks with the end upon which the bead is to be raised extending out through the cup-shaped opening and into the movable blocks where it is likewise clamped. Both sets of blocks are actuated by a cam clamp. After the tubing has been clamped in place a pneumatic cylinder pushes the movable blocks forward, compressing the tube, which expands into the cup-shaped recess to form the bead. The height of the bead is controlled by the movement of the cylinder arm and the size of the cutout in the blocks. The new tool offers a further advantage in that it increases the wall thickness of the tube in the area around the bead, adding to the strength of the bead. The Glenn L. Martin Company.



The Meriam micromanometer.

Salvaging Turret Castings

A large percentage of the aluminum turret castings that previously had to be rejected because of porosity and hollow spots are now being repaired by a new process in which the porous material is replaced with welding metal.

Under the new process the surface defects in the casting are first removed by grinding or chipping out the porous material. The casting is then preheated to 200 to 300°F. either in a furnace or by application of local heat. Next the cavity is welded or filled with weld metal, using a carbon arc and a 5 per cent silicon Aluminum Weld welding rod. Finally the welds are cleaned and filed smooth, and the weld area is neutralized.

The important features of the new process are the preheating of the casting and the use of a carbon electrode in combination with the metal welding rod. The preheating simplifies the welding operation and lessens the possibility of cracks by lowering the temperature differential between the point of the weld and the surrounding metal. High heat at the point of weld is avoided. The use of the carbon electrode with a normal metal welding rod provides a better adhesion between the weld metal and the aluminum casting than when the metal welding rod is used by itself as an electrode.

The new method of repairing defective castings is limited in use to low-stressed areas. Porosity or hollow spots are determined by X-ray. Following the welding the casting is again X-rayed to insure a perfect blend between the weld metal and the casting. Not only does the new method permit the rapid salvaging of castings that are urgently needed on the production line, but it is also resulting in the saving of considerable quantities of critical material, as well as the labor used in making the casting. The Glenn L. Martin Company.

Meriam Micromanometer

For calibrating low-pressure instruments and as a convenient manometer for reading pressures and vacuums, the Meriam Micromanometer permits readings to ±0.001-in. water pressure. It can be handled successfully by the average operator. Meriam Instrument Company, Cleveland.

FIGHTING STARS OVER BERLIN

There they go again . . . American bombers over Berlin. Guided by star American pilots . . . manned by star American crews . . . powered by star American engines . . . produced by star American workers.

For these fighting planes over Europe and other theatres of war, Lawson workers have contributed many types of precision aircraft engine parts. Lawson employees, star workers in the battle for victory, are again being honored for their long record of war production.

This new fighting star which adorns our "E" pennant marks the third citation received for meritorious war service in a highly specialized field. Lawson workers dedicate themselves anew to the task of producing star war materiel to bring the day of victory closer.

FIRST "E" AWARD April 29, 1943 — SECOND "E" AWARD October 30, 1943 — THIRD "E" AWARD May 17, 1944

LAWSON

Established 1933

Machine and Tool Company

MALDEN, MASS.

MANUFACTURERS OF PRECISION MACHINE TOOLS AND AIRCRAFT ENGINE PARTS

Small Part in a Big Role...

THEY'RE not large, those strands of Baldwin roller chain belt. Yet the part they play is a big one. For the successful operation of our warplanes depends, to a great extent, on their instantaneous response to the commands of the pilot and crew.

The ability of Baldwin roller chain belts to absorb tremendous shock loads . . . their ability to operate efficiently, regardless of temperature changes and atmospheric pressure . . . their high strength to low weight ratio and unfailing accuracy of operation are a natural development of Baldwin's wide experience working with designers and builders of aircraft.

The positive grip of Baldwin roller chain belts and terminals controls such important points as:

Ailerons	Nose Wheel Doors
Wing Flaps	Sliding Hood
Rudders	Power Turrets
Elevators	Arresting Hook
Bomb Bay Doors	Retractable Landing Gear
Tail Wheel Doors	Control Column

For complete information on Baldwin roller chain belts and for help in selecting the right type and size of roller chain belt and accessories, send for your free copy of the interesting, informative Engineering Handbook No. 67. Baldwin-Duckworth Division of Chain Belt Company, 355 Plainfield Street, Springfield 2, Mass.

BALDWIN

ROLLER CHAIN BELTS FOR AVIATION . . .

Extruded Vinyl Tubing

Newly developed vinyl tubing, designed to include the usual electrical properties but with improved heat-endurance characteristics and resistance to oil embrittlement, gasoline, or benzol, is now being produced commercially. Designated as Natvar 400 Series, this tubing is available on the same priority basis as standard vinyl tubings.

The manufacturer states that wires insulated with Natvar 400 may be soldered without special care or technique and without flow or opening of the tubing near the point of soldering. It is tough, resistant to tear, has tensile strength in excess of 3,000 lbs. per sq.in., with elongation from 170 to 410 per cent depending on type of tubing, and remains flexible down to −80°F. It is chemically inert and is suitable for oil lines, sheathing, and other protective coverings in applications where adverse oil, solvent, or acid conditions are severe and where protection from chemicals or vibration is required over a wide temperature range. The National Varnished Products Corporation, Woodbridge, N.J.

Adjustable Shear

The Di-Acro Shear No. 3 incorporates all the changes and refinements that have been developed from actual operating experience and the manufacture of nine different production models.

The construction includes a precision adjustment for accurately stopping blade travel, permitting the shear to be readily arranged for a large variety of slitting and notching operations with close tolerances.

A metal stripping guide, moving with the shear blade, is mounted upon the unit, allowing it to be employed for stripping all types of materials within the capacity of the shear. A delivery chute, built within the unit, delivers all materials, fabrics, and tissues at any speed within the ability of the operator to feed the shear. This feature allows material that has been sheared to be automatically loaded into a receptacle without attention from the operator.

All bearings are adjustable for wear and alignment and are rifle-drilled for complete lubrication to all points of friction. Both shear blades are adjustable for tolerances in shearing as well as for the control of the angularity of pitch, which can be quickly varied as desired for the shearing of all types of materials, ranging from heavy steel sheet and spring-tempered materials within the capacity range of the unit, to the lightest of fabrics and tissues. O'Neil-Irwin Manufacturing Company, Minneapolis.

Glass-Fiber Insulation

Glass fibers with a diameter measured in ten-thousandths of an inch and weighing only $^4/_{100}$ lb. per sq.ft., when bound with a thermosetting resin and formed into $^1/_2$-in.-thick sheets, are being used in the cabins and flight decks of certain types of war planes to provide insulation against the cold at high altitudes and to deaden sound. The fibrous glass sheets are incombustible and are stated to be the lightest inorganic material commercially available for the soundproofing and insulation of planes. Another important factor is that the sheets gain less than 1 per cent of their own weight from moisture in the air when subjected to temperatures of 125°F. and to 90 per cent relative humidity. The fibrous glass sheets are known as Fiberglas Type XM-PF. Owens-Corning Fiberglas Corporation, Toledo.

Four-Way Hydraulic Selector Valves

Lightweight Altair four-way hydraulic selector valves, for $^3/_8$-, $^1/_2$-, and $^3/_4$-in. tube size, incorporating self-seating plastic poppets, are available under AN specifications for aircraft, as well as for industrial use. One of the features of these valves is the use of plastic poppets developed by the maker. Special characteristics claimed for these poppets, which eliminate the necessity for inserted seats, include their ability to wear "in" instead of "out" and the fact that they can be removed without disassembling connecting lines. These poppets are only one-sixth the weight of steel, are easily mounted, and are reported to have withstood endurance tests involving 550,000 cycles without exceeding leakage requirements.

The cored fluid passages in the permanent molded aluminum-alloy body are regarded as another feature. Oval instead of circular in cross section, they provide greater flow area, keeping pressure loss at a minimum without increasing the size and weight of the valve.

A specially balanced poppet design for the $^3/_4$-in. valve compensates for the increased handle torque and makes it easier to operate. In the $^1/_2$-in. unit, an alternative valve is available with integral check and relief valves. The relief valve guards against pressure failures caused by thermal expansion by permitting escape of fluid to the reservoir when the cylinder and its lines form a closed system. The valves are made for operating pressures up to 1,500 lbs. per sq.in. They range in weight from 11 oz. for the $^1/_4$-in. unit to 26 oz. for the $^3/_4$-in. size. Pacific Division, Bendix Aviation Corporation.

Detachable Coupling for Flexible Metal Hose

A detachable brass coupling for helical flexible metal hose in sizes from $^3/_4$-in. to $1^1/_2$-in. inside diameter is designed to be mechanically self-sealing. No brazing is employed and no heating of the hose takes place at the point where flexing and vibration place the greatest strain on the hose.

The unit consists of only four parts. These are the nut, back, stem, and split ring. When assembled, the convolutions of the hose and the metal braid are securely held by pressure between the members. The coupling is intended to withstand pressure tests of up to 800 lbs.

A further feature of design is the self-contained union which permits the pipe-thread end of the coupling to be screwed directly into the machine fitting and the union tightened without twisting the hose. Other features are repeated reuse and easy assembly with ordinary shop tools. Packless Metal Products Corporation, New Rochelle, N.Y.

Features of Hi-Shear Rivets

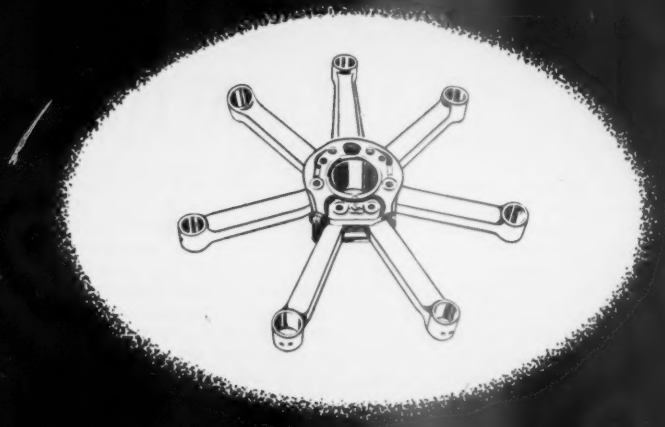
North American Aviation, Inc., has appointed a prime licensee for the manufacture of the new Hi-Shear rivets developed by that company. The rivet consists of two parts, the pin and the collar. The pin is made of alloy steel, heat-treated to a minimum tensile strength of 125,000 lbs. per sq.in., and cadmium-plated. As such hard material cannot be squeezed or hammered down to form a head, a malleable collar is provided. This collar is made of A17ST aluminum alloy anodized. The pins are stated to be the same as comparable sizes of AN hexagon-head aircraft bolts in regard to material, heat treatment, finish, and body diameter. The shear strength, therefore, is the same as that of the corresponding size of standard aircraft bolt. Although the rivets are installed with riveting equipment, they are essentially threadless bolts. The design permits the use of lightweight equipment, adaptable to high-speed riveting in even larger sizes than is practical with soft rivets.

The rivet set used is a simple one-piece tool that, by means of a conical bore in the end, swages the collar into the grooved pin end. A port is provided through which rings of excess collar material are automatically ejected by the pressure from succeeding rings. This special set can be used in either of two ways: as part of the bucking bar, or fitted to the riveting gun. The rivet is driven by a few simple operations. After the pin is inserted, a bucking bar is placed against the pin head and the rivet collar is slipped over the pin end. The set is placed over the collar and, as pressure is applied, the soft collar is forced into the groove at the end of the pin. The ring of waste material, pinched off when the collar is formed into a conical head, is expelled through the waste port of the rivet set. Pheoll Manufacturing Company, Chicago.

Film About Helicopters

The Helicopter is the newest in the series of aircraft motion pictures scheduled for production. It will be a two-reel, 35-mm. production tracing the development of rotating-wing aircraft and will show the principal differences between helicopters and autogiros. Designed for use as part of the South American film program of the Coordinator of Inter-American Affairs, *The Helicopter* will seek to dispel popular misconceptions about future uses of rotating-wing aircraft. Production will be supervised by Prof. Daniel Sayre, head of the Aeronautical Engineering Department of Princeton University. Midsummer release is planned. The Princeton Film Center, Princeton, N.J.

BETTER BEARINGS *with* INDIUM



New records for motor bearings life—several times pre-war's best—are being turned up despite the tight situation in white metals. In INDIUM, manufacturers found the answer.

By plating INDIUM onto the contact surface of the bearing and then diffusing it, metallurgists are able to impart a high concentration of INDIUM just where needed. The hardened surface of the bearing proved far more resistant to wear, oil-corrosion, and softening, without loss of its anti-friction value.

Several builders of aircraft engines, Diesels, and motor trucks are putting this life-giving element in bearing metals for their power units. Why not see what it can do for you?

ARMY E NAVY

INDIUM CORPORATION OF AMERICA

Personnel Inc. 49

THE INDIUM CORPORATION OF AMERICA

UTICA, N. Y.

New York Office: 60 East 42nd Street, New York 17, N. Y.

V-Way Hydraulic Vise

The Reimuller Precision V-way vise is designed to meet the problems of quantity-production requirements for holding or handling material. The unit can be mounted vertically and used as a production press on small precision upsetting, heading, and other small operations requiring dies or tooling. Only two levers are used in the hydraulic foot control. One applies pressure up to the rated tonnage. The other is for release and provides a two-speed return. No outside power is needed and the unit has provision for automatic elimination of air, making unnecessary the bleeding of the pump or oil lines. The operator's hands are free for work.

The new vise is portable to the extent that it is equipped with flexible hydraulic hose, which makes it available for use on other machines. Two sizes are made: one of 4-ton pressure with 4-in. opening, and one of 7-ton pressure with 7-in. opening. Reimuller Brothers Company, Franklin Park, Ill.

New Version of Republic P-47 Thunderbolt

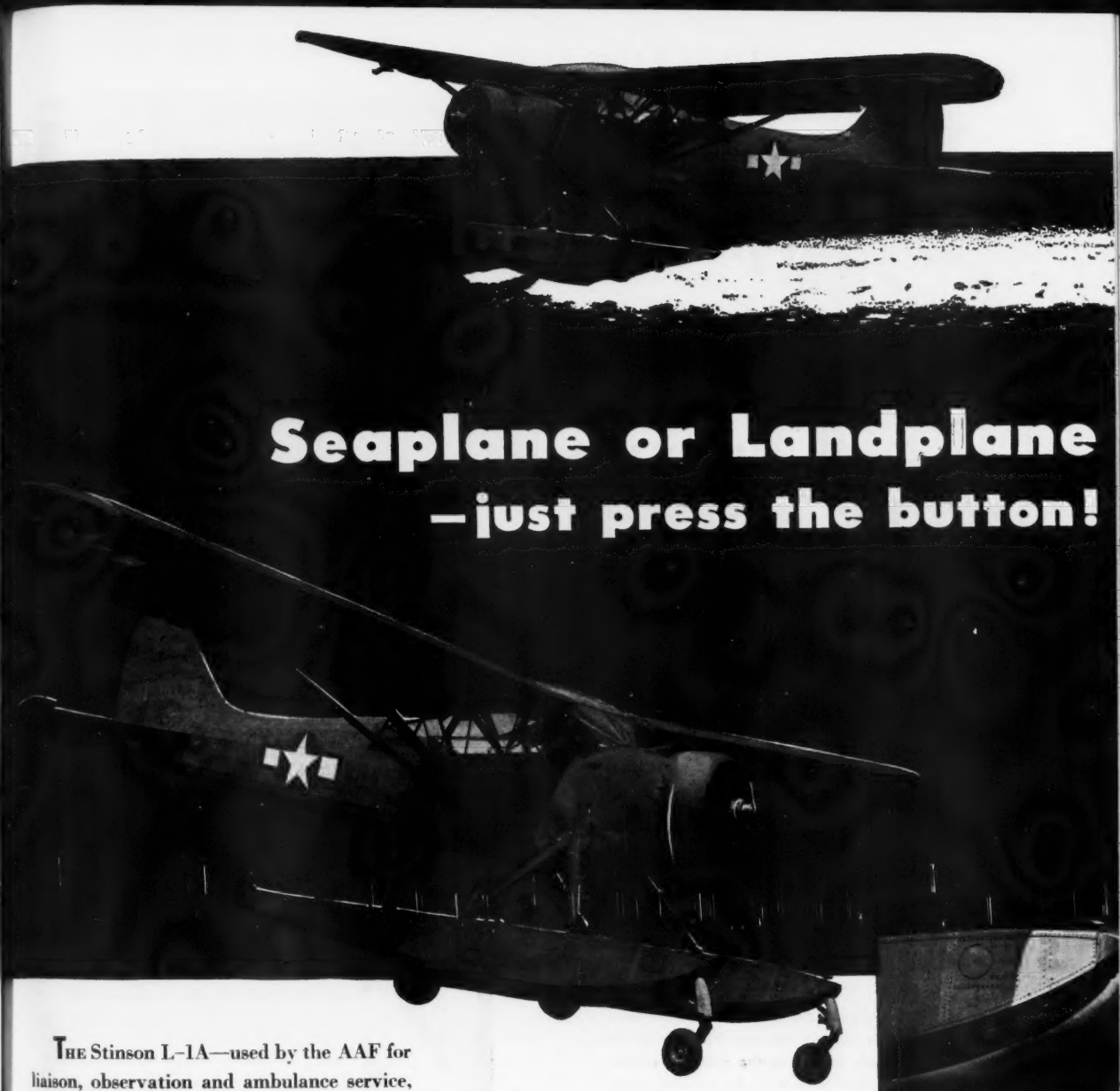
The manufacturers report that a new version of the P-47 Thunderbolt is in service with the Army Air Forces. Among its features, it is stated, is a considerably changed silhouette. Through water injection an increased amount of power is available for a longer period of emergency-power operation. Larger fuel capacity gives it double its earlier range of action, making it suitable as an escort fighter on long-distance bombing raids. A new type of propeller is stated to have added 400 ft. per min. to its climbing speed.

Another new feature is the "bubble" canopy. Absence of top and side framework gives the pilot unobstructed horizontal vision. The canopy is electrically operated. The flat-front windshield affords an undistorted front view. Maximum practical armor-plate protection is provided for the pilot.

The new Thunderbolt has eight 0.50-cal. machine guns, four in each wing. A new gun sight is centered to provide natural sighting. For bombing and dive bombing it can carry a 1,000-lb. bomb under each wing. Republic Aviation Corporation.

Welding-Demonstration Film

A new film prepared by the Navy Department on the use of welding in aircraft production gives a demonstration of the advancements made in this work under impetus of wartime requirements. It is confined to aircraft-production processes and shows the applications of welding in general and spot welding and other forms of resistance welding in particular. Although the film is planned for restricted use, it is now being exhibited by various Sections of the American Welding Society. When not being so used, the Society will endeavor to make the film available to individual manufacturers. Resistance Welder Manufacturers Association, Philadelphia.



Seaplane or Landplane —just press the button!

THE Stinson L-1A—used by the AAF for liaison, observation and ambulance service, needed a float with retractable landing gear, capable of operating from land, water or snow.

Army Air Forces brought their problem to Edo Aircraft Corporation, makers of floats. And Edo turned to HUB for design of the complex shock absorbing strut mechanism.

HUB engineers went to work, came up with compact, hydraulic landing gear struts which met the specific need. The pilot can turn a seaplane into a landplane, and vice versa, by merely pressing a button on the panel!

Specialists in hydraulics—pioneers and developers in controlled fluid power, HUB has long experience in the design, engineering and application of hydraulics. While our entire manufacturing facilities are now completely engaged in war production—our research and engineering departments are available for the consideration and development of hydraulic equipment needs for tomorrow's peacetime aircraft . . . Full information on request . . . Inquiries are invited.

Bow wheel fully retracted with all doors closed

Bow wheel fully extended —main doors closed

HUB INDUSTRIES, INC., *formerly* DOWTY EQUIPMENT CORPORATION

LONG ISLAND CITY, 4 • NEW YORK

SPECIALISTS IN HYDRAULIC EQUIPMENT FOR AIRCRAFT AND INDUSTRY

AEROMAC SWING-CHECK VALVE

● The exceptional simplicity and positive action of the Aeromac Swing-Check Valve aptly qualifies this special unit for service in the fuel and air supply lines of fighting aircraft. Designed with a minimum of parts, only seven in all, the Aeromac Swing-Check Valve is precision-constructed of corrosion-proof materials, and once installed, performs with attention-free dependability. Its automatic seal type action is an effective safeguard against the reverse flow of both liquid fuel and air or gas. Complete details on the application of this Aeromac Swing-Check Valve to supply systems will be sent promptly on request.

AERONAUTICAL MANUFACTURING CORP.
379 Fourth St. Niagara Falls, N. Y.

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★ *Control Valves* ★

MANUFACTURERS OF CONTROL VALVES, PRECISION GAUGES, PRODUCTION TOOLS AND MACHINED PARTS FOR THE AIRCRAFT INDUSTRIES

SHENANGO-PENN

Centrifugal Casting may be the answer!

THE aviation engineer who is looking for additional facilities to produce cylinder liners, bearings, rings, sleeves, seats, etc., will find that Shenango-Penn centrifugally cast products offer many advantages.

The process assures greater strength and purity and a fine, even grain structure not obtained in ordinary castings. Cylinders from 2″ to 26″ O.D. and up to 26 ft. in length can be furnished. Flanges and unusual shapes and sizes can be worked out. Machining time is reduced because there is less allowance for finish required.

Shenango-Penn's research and engineering experience are at your disposal to help solve any problems that will speed up production. We'll gladly send you our new Bulletin No. 143, or can have a representative call if you want immediate information.

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ALL BRONZES • MONEL METAL • ALLOY IRONS

SHENANGO - PENN

Connector Springs

A universal connector spring for steerable tail-wheel assemblies is adjustable in length to fit all makes of airplanes. It incorporates a universal joint designed to eliminate breakage of the spring tips. The adjustable feature enables the user to secure the correct tension for proper steering action. The spring is provided with a locked connection at one end, preventing its loss when operating on rough fields. Scott Aviation Corporation, Lancaster, N.Y.

Wire-Wound Surge Resistors

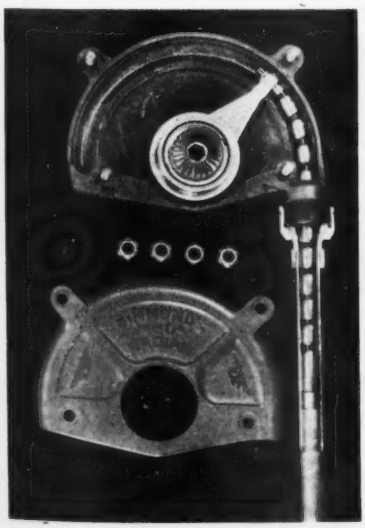
Developed for X-ray and other high-voltage applications, Shallcross Type 290 wire-wound surge resistors are stated to meet modern requirements for high-resistance units capable of handling high voltage while dissipating normally 200 watts. A typical application is their use in the constant-potential d.c. output of a high-voltage Kenetron rectifying system to stabilize the performance of the apparatus to which this high potential is being applied, the resistors operating either as bleeders or as voltmeter multipliers.

These surge resistors are wound on high-grade nonhygroscopic ceramic forms with insulated "nicrome" wire, single layer space-wound. The wire is protected with a special finish that resists heat and operates up to 450°F. Any degree of resistance from 1,000 to 3,000,000 ohms is available. Shallcross Manufacturing Company, Collingdale, Pa.

Chrome-Bonding Process

Precisionplate is the trade name of a method of uniformly and adhesively bonding chrome to the full thread form on a thread gauge. This process is designed to enable the adhesion, the toughness, and the thickness of the chromium to be controlled to a fine degree of precision. It is stated that the chromium is actually bonded to the steel with such adhesion that the plugs are chip-resistant. A microphoto shows that the chrome is relatively uniform from the crest, over the pitch diameter, to the root, making it possible for the gauge to give an accurate check throughout its entire life.

Among the advantages claimed is the increased resistance to corrosion caused by handling or by the atmosphere, as well as scoring, marring, and other damage resulting from rough handling. Precisionplate thread plugs are stocked in standard sizes and have an accuracy of Class X tolerance in lead, angle, and pitch diameter. Special plugs can be made to order. The Sheffield Corporation, Dayton, O.



The radian unit made by Simmonds Aerocessories, Inc., may be mounted directly upon the instrument it actuates. It converts the linear motion of the linkage in a push-pull control into rotary motion, transmitting such rotary motion to the shaft of the component it serves.

Push-Pull Unit for Rotary Motion

The Radian unit is a device providing rotary-motion action from push-pull operation. It is specifically designed for use in connection with propeller governors, carburetor air controls, supercharger controls, and similar aircraft installations.

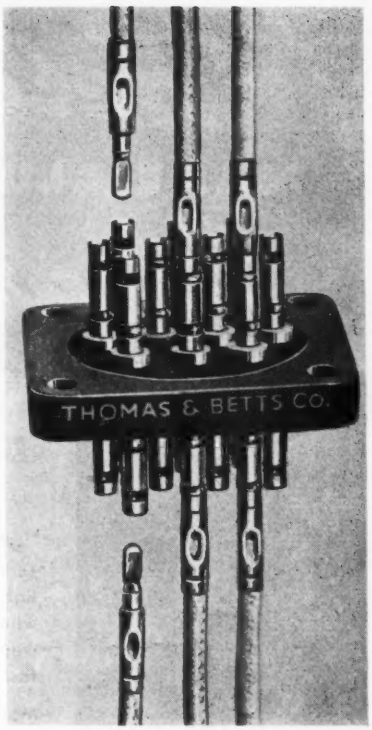
Weighing approximately 12 oz., the unit is intended to replace the pulley-and-cable and rod-and-bellcrank assemblies. It has but three basic parts: a housing, a lever arm, and a bushing. The housing contains the track of the linkage path, the lever arm carries out the angular travel, and the bushing transfers the angular travel to the shaft to be actuated. The bushing is self-aligning and corrects for end play, offset, or misalignment between the unit and the component it serves.

Serrated teeth provide for fine adjustment between the lever arm and the shaft it actuates. The unit is completely enclosed, with sealed-in lubrication. It is reported to have satisfactorily passed tests for operation at low temperatures as specified by the Air Forces winterization program. Simmonds Aerocessories, Inc., New York.

Control Box for Temporary Electric Circuits

Designed primarily for shipyards and aircraft plants where a number of temporary electric circuits must be set up and torn down quickly, a newly designed "scatter box" makes possible a central control of such circuits, with protection by circuit breakers. The device is built for from four to eight circuits, with or without neutral. Circuits are protected by 15-amp., 115-volt, single-pole, Type MO Multibreaker circuit breakers. For heavier loads, 20- or 25-amp. breakers can be substituted.

The hinged cover of the scatter box can be padlocked, and openings for plug receptacles similar to Hubbel No. 7557-G are provided. One 1-in. knockout in each end is included and the box has a pair of ears for hanging. Receptacles and internal wiring are not provided. Square D Company, Detroit.



Sta-Kon straight-pull disconnect fittings. These are intended to act as "mechanical circuit breakers" as a protection against accidental external strain.

Straight-Pull Disconnect Fittings

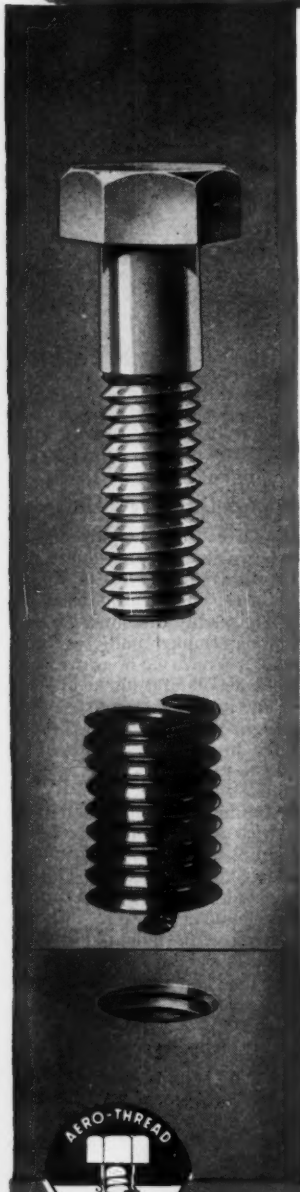
T&B Sta-Kon straight-pull disconnect fittings are designed to connect, disconnect, and reconnect wires of No. 22 to No. 10 sizes. They are wiring devices that are readily disconnectable on straight predetermined pull, for rapid replacement and rewiring of airplanes at maintenance depots and for facilitating original sectionalized construction. These straight-pull disconnect fittings are intended to act as mechanical circuit breakers as a protection against accidental external strain.

Almost unlimited combinations can be made with straight-pull disconnect tips and couplers because the tips are identical and interchangeable. The fittings are included in the group of pressure (solderless) connectors and are easily installed with standard Sta-Kon pressure tools, operated manually or by power. The Thomas & Betts Company, Inc., Elizabeth, N.J.

Three-Part Inspection Instrument

Designed for an extremely wide range of angle checking, a three-part precision inspection combination features a 7-in. by 12-in. by 12-in. sine angle square that permits right- and left-hand horizontal angle measurement up to 75°. When used in conjunction with a surface plate angle plate, vertical right- and left-hand angle measurements can be attained, together with a wide range of projection checking. It may also be used separately as a

Heli-Coil Inserts
MAKE ALUMINUM TAPPED THREADS
Wear Like Iron!



"Heli-Coil" Screw Thread Inserts give the protection of steel to light metal products at the points where they are most vulnerable to wear—in holes tapped for threaded fastenings.

Made of precision-shaped helical coils of stainless steel or phosphor bronze wire, these Inserts are installed in holes tapped for the American National System.

Then, when the holding screw or stud is inserted, its entire wearing action is on the hard metal Insert, instead of on the soft metal boss. The light metal threads are armored against abrasion, stripping and seizing. The entire assembly is protected against serious breakdowns in the field.

The wide acceptance of "Heli-Coil" Inserts by the aircraft industry—today's top user of light metals—gives promise of their unlimited usefulness throughout all industry after the war.

Wherever holes must be tapped in light metal parts, "Heli-Coil" Inserts fight friction, help build a stronger, lighter product. They may well be the answer to some of your problems. Send for detailed literature today.

THE SCREW SYSTEM WITH THE ANTI-FRICTION THREAD LINING!

U. S. and Foreign Patents Issued and Pending

Heli-Coil INSERTS
ARE USED FOR ORIGINAL INSTALLATIONS IN ARMY, NAVY AND TRANSPORT AIRCRAFT ENGINES, ACCESSORIES AND PARTS
ALSO FOR SALVAGE, MAINTENANCE AND FIELD SERVICING OPERATIONS

Heli-Coil INSERTS SAVE

TIME — Can be installed with power tools in a fraction of the time required for solid screw bushings.

WEIGHT — Weigh one-fifth as much as screw bushings of the same diameter.

SPACE — Occupy less than half as much cross sectional area as solid bushings, permitting more latitude in design.

METAL — Made from precision-shaped wire with no waste, require about one-tenth as much metal as solid bushings made from bar stock.

AERO-THREAD

AIRCRAFT SCREW PRODUCTS COMPANY, INC.
47-23 35th STREET • LONG ISLAND CITY, 1, N.Y.

small surface plate angle plate. It is of steel construction.

The second unit of the combination is a heavy-type surface plate angle plate with hardened and ground cylindrical posts and cross plates. The posts are hollow and ventilated to balance inner and outer temperatures. The base is made with extra-heavy reinforcing ribs of special design to maintain accuracy.

The third member of this group is a utility trisquare made in sizes from 4 in. to 16 in. It has a solid cylindrical post for point-of-tangency and line accuracy, inside, outside, and sidewise. Steel in all three instruments is aged, heat-treated, and tested to 60–64 Rockwell C hardness. The manufacturer states that they can be economically reconditioned if unavoidably abused. Thomas Tool & Machine Company, Pontiac, Mich.

Precision Pin-Gauge Sets

Precision pin sets, number drill, letter drill, and fractional sizes are furnished in compact cabinets. Number drill sizes 1 to 60 and letter drill sizes A to Z (86 pins), as well as fractionals $^1/_{64}$ in. to 1 in. in increments of $^1/_{64}$ in. (64 pins), are of gauge steel, hardened to 60–63 Rockwell C scale, and finished by the Uppco-Lapped method. Tolerances are made to individual specifications.

The walnut-finished cabinets are especially designed and fitted for their purpose. Brass strips identify each gauge at its position. The gauges are progressively stored for easy access. The smaller pins are in glass vials with heavy plastic screw tops and felt cushions at the bottom for added protection. United Precision Products Company, Chicago.

Ignition-Service Instrument

An instrument designed by United Air Lines engineers to detect any leakage in the insulation and ignition harnesses of airplane engines is known as an ignition "megger." It consists of a portable vacuum-tube voltmeter that applies 1,200 volts d.c. across the insulation being tested. Any leakage in electrical energy is shown by a meter, directly calibrated in megohms. A resistance of 2,000 megohms causes a half-scale deflection. On the right of the scale lower resistances down to five megohms are directly indicated.

A green-yellow-red arc indicates the approximate characteristics. The left, or infinity side of the scale, is marked "good"; the right, or zero-resistant side of the scale, is marked "bad"; the yellow, or "doubtful" portion of the arc, extends between 20 and 200 megohms.

Because of the vacuum-tube voltmeter circuit used positive indications are obtained, since all resistances are shown by proportionate needle deflections. A mechanic is able to note visually the indications of his servicing operation. Because the instrument uses approximately 500 volts less than the spark-plug firing voltage without compression, there is no need to remove the magneto blocks, an operation requiring much time and effort. Consequently, any trouble resulting from moisture or faulty insulation can be serviced from the plug end of the harness.

The instrument is housed in an oak wood case, 9 in. deep by 11 in. wide by $14^1/_2$ in. high. It weighs 26 lbs. and is entirely self-contained, having internal dry-cell and "B"-battery power. However, storage batteries may be used in place of dry cells for supplying filament power if desired. United Air Lines.

Lightweight Electrode Holder

The "Suregrip Stubby" is a new, lighter, shorter, smaller-diameter electrode holder of 300-amp. capacity. In operation, its principal features are its adaptability to close-quarter work, its high electrical conductivity, 60°-angle grip on the rod, and the fact that it enables the welder to burn rods down to the last inch, thus saving up to 14 per cent in rod costs.

Of the same design as the standard Rod Saver holder, the Stubby model 3Rs has capacity up to 300 amps., weighs only 14 oz., is $8^1/_4$ in. long, with handle diameter of $1^1/_4$ in. The new handle encloses all metal parts and there are no screws to work loose and cause arcing. Martin Wells, Los Angeles.

Cross-Pointer Landing Instruments

The Westinghouse Electric & Manufacturing Company is now manufacturing electronic blind-landing instruments that are used to guide pilots back to their home airfields and help them to find runways in darkness or bad weather. With this instrument system the pilot gets directions for descent by watching two crossed pointers and two signal lamps on his instrument panel. The plane is equipped with two radio "landing" receivers, which are tuned to the directional beams issued by the ground equipment. One receiver, responsive to the "localizer" or on-course beam, moves the vertical pointer on the instrument dial. The second receiver, which responds to altitude signals, operates the horizontal pointer.

Four separate radio transmitting stations and two antenna systems at and near the airport comprise the ground radio equipment. They send out beams that first indicate the pilot's approach to the field and then mark the field's boundary, establish the invisible glide path that leads to the runway, and signal directions for keeping the glide to the field neither too shallow nor too steep. Vertical guidance to maintain the position of the plane in relation to the runway is provided by three of these transmitters. One furnishes the glide-path radio beam; the other two transmitters are "markers" whose beacons, transmitted vertically, light the lamps on the pilot's instrument panel by means of the plane's marker receivers. The first flash tells the pilot he is a few miles from the airport and that he should prepare for the glide path by maintaining an altitude of 1,500 ft. When a similar beam from the second marker lights the other lamp the pilot knows he has reached the boundary of the field.

The homing path, or localizer, is produced by ultra-high-frequency radio transmitters feeding a pair of sharply directional antenna systems, consisting of two loops. Signal strength emanating from the loops is almost equal if the plane is on course. The vertical pointer of the instrument interprets this by assuming an upright position. Should the plane wander to the left or right of the course, the corresponding signal predominates, causing the vertical pointer to veer in that direction, and in an amount roughly proportional to the distance the plane has flown off course. The horizontal pointer remains in position across the center of the dial so long as the plane is moving earthward at the correct angle. If the glide is too shallow, the pointer rises; if it is too steep, the pointer moves downward. Westinghouse Electric & Manufacturing Company.

Changes of Address

To facilitate the prompt receipt of copies of the Journal and Review, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

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Institute News

New Membership Roster

The Institute is planning the publication of the *1944–1945 Membership Roster* to be printed and distributed to all members in the latter part of this year.

Self-addressed reply cards have been sent to all members for the necessary information. Each member is urged to fill in the card and return it to the Institute at the earliest possible moment.

The card also provides room for the correction of names and addresses for the mailing lists of the Institute. It is important when changing mailing address to include a postal zone number; this facilitates the delivery of mail.

Gifts to the Aeronautical Archives

Dr. Alexander Klemin gave more than 800 books and bound periodicals, including rare volumes of British *Reports on the Progress of Civil Aviation*, and seven cartons of blueprints, clippings, reports, catalogues, and unbound periodicals, adding to his previous generous gifts. Dr. Otto Kallir gave 75 numbers of American and foreign air-mail periodicals, 33 air-mail catalogues, aeronautical buttons and jewelry, and two books. These were *Onomatologia, Curiosa Artificiosa et Magica, oder Ganz Näturliches Zauber-Lexicon*, Nuremburg, 1764, containing directions on making kites, a description of an artificial fly controlled by magnetism, and other aeronautica, and the *Offizieller Katalog* of the Internationale Luftschiffahrts-Ausstellung, Frankfurt, 1909.

A model of the P-47 Thunderbolt fighter was received from the Republic Aviation Corporation. An air globe, with a measuring tape for air-line distances and hours at 250 m.p.h., was given by American Airlines, Inc. Photostat copies of the first two numbers of *Sales and Service News Letter*, now published as *Trade Winds*, were received from the Wright Aeronautical Corporation through the courtesy of H. E. Linsley.

The British Air Commission in Washington added 47 *British Air Ministry Translations* to the large number previously given. Berry Brothers, Inc., gave 14 aeronautical drawings. A program of the first annual banquet of the Aeronautical Society, April 27, 1911, was received from William H. Dey. A cutaway drawing of the Boeing Flying Fortress was received through the courtesy of N. W. Ayer & Son, Inc. An ash tray made from an airplane engine piston was given by Charles H. Babb. Two pamphlets on Pan American-Grace Airways, Inc., were received from Harold J. Roig. Fred W. S. Locke, Jr., sent seven aeronautical periodicals.

Fourteen insignia of the China National Aviation Corporation, American Red Cross, American Field Service, and military units in southeast Asia were received as a gift from Major Gen. Howard C. Davidson. Sam S. Beck sent three insignia of the Murray Corporation. A seven-volume set of *Aviation Chemistry, 1914–1918*, and *Book List No. 1, Technical Publications for Army Air Forces Field Technical Libraries*, were received from Headquarters of the Army Air Forces through the courtesy of Capt. Robert E. Scudder. Four cartons of aeronautical periodicals were received from the Eclipse-Pioneer Division of Bendix Aviation Corporation.

Identification badges and insignia were sent by Adel Precision Products Corporation; Aircooled Motors Corporation; Aircraft Accessories Corporation; The BG Corporation; Breeze Corporations, Inc.; Chandler-Evans Corporation; Cox and Stevens Aircraft Corporation; The de Havilland Aircraft of Canada Ltd.; Fairchild Camera & Instrument Corporation; Flottorp Manufacturing Company; General Tire & Rubber Company; Harlow Aircraft Company; Kellett Aircraft Corporation; Link Aviation Devices, Inc.; National Aircraft Equipment Company; Northwest Airlines, Inc.; Pacific Aviation, Inc.; Pratt & Whitney Aircraft, Division of United Aircraft Corporation; Republic Aviation Corporation; Ryan Aeronautical Company; Spartan Aircraft Company; Thompson Products, Inc.; Thompson Aircraft Products Company; and Transportes Aereos Centro Americanos.

Among the donors of other gifts were the Associate Committee on Aviation Medical Research of the National Research Council of Canada, the Civil Aeronautics Board, Office of the Coordinator of Inter-American Affairs, Office of War Information, and Congressional Committees on appropriations, and military and naval affairs.

An Appreciation of A. Leo Stevens' Gifts

A good friend and benefactor of the Aeronautical Archives of the Institute died on May 8. For several years he has been sending, for the biographical and subject files of the Archives, collections of clippings and photographs from as early as 1896. These notices have filled in many gaps in the historical files.

In 1943 he presented to the medal collection a gold medal given to him in 1900. Engraved on it is "A. Leo Stevens, Aeronaut, Champion of America." Mr. Stevens not only gave his great files but wrote to many friends who had been active in aeronautics in the early days and requested them to send their aeronautical photographs to the Archives. This generous interest of Leo Stevens will always be remembered by the Institute.

New Corporate Member

Jack & Heintz, Inc., Bedford, O., has recently become a Corporate Member of the Institute. The firm was originally founded at Palo Alto, Calif., in February, 1940, by William S. Jack and Ralph M. Heintz, as Jack & Heintz, Ltd. In November of that year it moved to its present location just outside of Cleveland and was incorporated under the laws of the State of Ohio with its present name. The company developed an improved aircraft-engine starter, and success in producing this starter led to an assignment from the United States Government to manufacture automatic aircraft pilots and accessories. The manufacture of this type of precision instrument was developed on a quantity basis. The firm operates factory groups in Cleveland and Maple Heights as well as the main plant at Bedford.

In addition to airplane-engine starters, automatic pilots, and accessories for airplanes and gliders, the firm also manufactures high output generators, speed valve controls, drain traps, oil-pressure valves, directional gyros, horizon gyros, energizers, cylinders and crankcases for auxiliary generator drives, and special motors for landing-gear retractors, bomb-bay doors, and wing flaps.

Sections and Branches

New Cleveland Section

A new Section of the Institute has been organized at Cleveland. Its first meeting was held May 18 at the Case School of Applied Science. Officers were elected as follows: Chairman, John R. Weske, of Case School of Applied Science; Vice-Chairman, Willson H. Hunter, of the National Advisory Committee for Aeronautics; and Secretary, T. H. Caldwell, Jr., of The Dow Chemical Company. Election of the executive committee and appointment of other committees was postponed until a subsequent meeting.

Proper Identification of High Speed Steels Saves Time

Plants using both tungsten and molybdenum types of high speed steels should give serious consideration to the establishment of an efficient identification system—one that will keep the steels separated from bar stock to finished tool.

The danger of spoilage is particularly acute when mixed lots get into the heat treaters' hands.

The recommended hardening temperatures for tungsten types are 100° to 200°F. higher than those for the molybdenum types. Treating the latter so far above recommended temperatures will spoil them for cutting tool service. Treating the tungsten types that far below recommended hardening temperatures will not develop the required red hardness.

Heat treaters sometimes use the "sweating" of tungsten types as an indication that the steel is up to proper hardening temperature. *THIS DOES NOT HOLD WITH MOLYBDENUM TYPES.* In their case, a pyrometer should always be used to determine when the steel is at the recommended hardening temperature.

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At the first meeting three of the members gave reviews of some of the papers presented at the Light Aircraft Meeting recently held in Detroit, after which there was active discussion of the points brought out in the papers.

Seattle Section

A meeting of the Seattle Section was held on March 15. The speaker of the evening was Wellwood E. Beall, Vice-President of Engineering, Boeing Aircraft Company. He told about his experiences and the impressions he gained during his trip to England and gave a detailed description of how a typical bombing mission is organized and carried out.

Regional Meeting

The I.A.S. Branches of Illinois Institute of Technology, Case School of Applied Science, University of Notre Dame, and Purdue University participated in a Regional Meeting held at Purdue University on May 29.

A technical session was held on the morning of May 29. Demonstrations were given of the Purdue wind tunnels and structures-testing equipment. Technical papers were presented and discussed. These papers were as follows: (1) "Design Information Obtained from Tests of Thin-Walled Celluloid Cylinders," by Don Gault, Purdue University; (2) "Visual and Audible Demonstration of Turbulence Phenomena," by R. Carleton, Case School of Applied Science; (3) "Investigation of Airflow Phenomena with Small Heated Air Streams by Schlieren Method," by R. F. Robinson, Case School of Applied Science; (4) "Post-War Aviation Possibilities in Brazil," by Waldemar Neuss, Purdue University; (5) "Demonstration of Flutter Phenomenon," by John Loufek, Purdue University; (6) "Flow Visualization," by Philip Myers, University of Notre Dame; (7) "Shear Center of a Closed Section," by Sidney Baker, Illinois Institute of Technology.

The afternoon sessions were held at Purdue Airport where University and Navy equipment were inspected. Demonstrations of the torque stand, the CFR engine, and the Link trainer were given. Several Naval Aviation cadets acted as guides for the trip through the Navy section of the airport.

At 6:30 in the evening the participants assembled for a dinner at the Baptist Church. H. H. Johnsen, Chairman of the Purdue Branch, acted as toastmaster and the guests of honor were introduced. These were Dr. Weske, Case School of Applied Science, and Dean Potter, Professor Solberg, and Professor Wood, Purdue University. Dr. Weske gave the principal address.

Prizewinners chosen by the committee of professors were announced as follows: First prize, D. E. Gault; second, R. Carleton; third, R. F. Robinson; fourth, Waldemar Neuss; fifth, J. Loufek; sixth, Philip Myers; seventh, S. Baker.

The old and the new: Glenn L. Martin is shown here with a model of his first airplane and a model of the Mars.

News of Members

Archie Anders has been appointed Chief Engineer of Rusking Products Company, Inc.

Maurice A. Biot, on leave of absence as Assistant Professor of Mechanics at Columbia University, has been commissioned a Lieutenant in the U.S. Navy and assigned to the Bureau of Aeronautics.

Reid Bogert has been announced as the Project Engineer of the El Segundo Division of Douglas Aircraft Company, Inc., in charge of the new BTD Navy bomber-torpedo plane.

Le York Cheeseman has joined the Philadelphia Public School System as Instructor of Vocational Education for National Defense.

Edward L. Denison has been commissioned an Ensign in the U.S. Naval Reserve.

Gilbert DeVore has been appointed a Flight Research Engineer at the Aircraft Engine Research Laboratory of the N.A.C.A.

Francis J. Di Salvo has joined Trans-Canada Airlines at Montreal as an Aeronautical Engineer.

William R. Enyart, President, General Manager, and Treasurer of Simmonds Aerocessories, Inc., has become President of the National Aeronautic Association. He was formerly Vice-President.

Albert Gail has joined McDonnell Aircraft Corporation as Aerodynamicist.

Adolfo F. A. Garcia has joined Taca Airways Agency as Maintenance Engineer.

Stuart H. Hahn has been named Resident Project Engineer at Air Research Manufacturing Company of Arizona.

James Louie has been appointed to the faculty of the University of Washington as an Associate in the Physics Department.

Raymond D. MacCart, formerly Vice-President and Chief Engineer at Brewster Aeronautical Corporation, has joined Consolidated Vultee Aircraft Corporation in the capacity of Assistant Chief Division Engineer.

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F.I.Ae.S., M.S.A.E., F.R.Ae.S.

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J. Wallace McDonald has entered the employ of P-V Engineering Forum, Inc., as Aerodynamicist.

Jerome B. Meyer has been comissioned a Second Lieutenant in the U.S. Army Air Forces.

Norton B. Moore, formerly Chief of Aerodynamic Research of the Airplane Division of Curtiss-Wright Corporation, has been advanced to the office of Associate Director of Research. He will continue to make his headquarters at the Buffalo plant of the Corporation.

Sanford A. Moss, Consulting Engineer in the Supercharger Engineering Division of General Electric Company, received the New England Award for 1944, presented by the Engineering Societies of New England, Inc.

Robert R. Osborn, formerly Engineering Advisor at Bell Aircraft Corporation, has been appointed to the office of Consulting Engineer of the Helicopter Research Division of McDonnell Aircraft Corporation.

Frank N. Piasecki has been elected President of the P-V Engineering Forum, Inc.

Charles H. Potts has received his commission as a Captain in the U.S. Army Air Forces.

Bernard L. Prenovich has joined the Sikorsky Aircraft Division of United Aircraft Corporation as Chief of Structures.

Andrew Reid has been named Assistant Chief Inspector of the Aircraft Division of Willys-Overland Motors, Inc.

Reinhardt M. Rosenberg has joined Consolidated Vultee Aircraft Corporation as Structures Engineer.

Ernest B. Sporleder has been advanced to the position of Administrative Engineer at the Santa Monica Plant of the Douglas Aircraft Company, Inc.

Asher Tischler has returned from service with the Army Air Forces to the Propeller Division of Curtiss-Wright Corporation, where he is Experimental Test Engineer.

Ralph H. Upson, Chief Aeronautical Engineer of the Aircraft War Production Division of the H. J. Heinz Company, has become Chief Aeronautical Engineer for the War Production Board Research Project at the College of Engineering of New York University. The project seeks to develop wind as a source of electric power on a large scale.

Richard R. Vineyard has been named Chief Engineer of the Plastics Department of Winer Manufacturing Company.

Donald M. Wheat has become an Engineering Draftsman at a U.S. Naval Air Station.

Paul G. Zimmermann, formerly Quality Control Manager at Consolidated Vultee Aircraft Corporation, has become Consulting and Management Engineer in the firm of Jones and Zimmermann.

Members Elected

The following applicants for membership or applicants of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Dowd, Raymond Ernest, Chief Engineer, Aero. Div., The Russell Manufacturing Co.; President, Trumatic Co.

Herzog, Adolph, Chief Engineer, Lavelle Aircraft Corp.

Marchev, Alfred, President, Republic Aviation Corp.

McCoy, Howard Monroe, Ae.E.; Col., Chief, Propeller Lab., Engineering Div., Matériel Command, U.S. Army Air Forces.

Parke, Nathan Grier, III, A.B.; Sr. Aero Engineer, Bureau of Aeronautics, Navy Dept.

Elected to MEMBER Grade

Anderson, David Forgham, B.Sc. in C. & M. Engineering; Group Captain, R.A.F.

Archer, Waine, Jr., B.S. in Ae.E.; Group Engineer, Armament Modification, Boeing Aircraft Corp.

Baker, Donald Lee, B.S.; Aero. Engineer, Bureau of Aeronautics, U.S. Navy.

Bedsworth, William Gerard, Jr., M. of Sc.; Meteorologist, American Airlines, Inc.

Beers, Norman Ritner, B.Sc.; Lt., Instructor—Meteorology, U.S.N.R.

Cairns, Edmund Burke, Methods Engineer, The de Havilland Aircraft of Canada Ltd.

Dale, Robert Baker, B.S. in Ae.E.; Supervisor Factory Liaison, Briggs Manufacturing Co.

Devorn, Oleg J., B.S.Arch.; Structural Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Dobson, Franklin Alver, B.Sc. in E.E.; Chief Aero. Engineer, Aeronautical Products, Inc.

Deutsch, Murray Lewis, M.S.; Associate Physicist, Engineering Division, Matériel Command, U.S. Army Air Forces.

Echard, Charles Paul, D.Sc.; Manufacturing Engineer, Factory "B," Lockheed Aircraft Corp.

Erdoss, Bela Kalman, M.Sc. in M.E.; Research Asst., Institute of Research, Lehigh University.

Evans, Thomas, B.S. in C.E.; Head of Structures & Weights, Curtiss-Wright Corp.

Fangor, Mieczystaw Wojciech, Group Leader, Victory Aircraft Ltd.

Hiscocks, Richard Duncan, B.A.Sc.; Head, Aircraft Structures Section, National Research Council.

Hamburg, Merrill Clarence, B.S.A.M.; Supervisor Vocational Education, Detroit Board of Education; Asst. Prof. of Vocational Education, Wayne University.

Hanson, Louis Philip, B.S. in E.E.; Engineer, Boeing Aircraft Co.

Henley, John Woodson, Asst. Chief Flight Engineer, Intercontinental Div., TWA, Inc.

Hough, W. S., B.S.; Manager, Aircraft Section, Johns-Manville Corp.

Loughridge, Donald Holt, Ph.D.; Prof. of Physics, University of Washington.

Maloney, William Patrick, B.S.; Group Engineer (Fuselage), Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

McBrearty, Jerome F., B.Ae.E.; Structural Engineer-Division Engineer, Factory "B," Lockheed Aircraft Corp.

McCabe, Arthur, S.M. in Ae.E.; Lt., Asst. A.A.F. Resident Representative, U.S. Army Air Forces.

Meshejian, John Mihran, Ae.E.; Sr. Structural Engineer, The Glenn L. Martin Co.

Mount, Wilbur Shepherd, B.S. in M.E.; Engineer, Socony Vacuum Oil Co., Inc.

Otter, George Edward, Chief Engineer, Fleet Aircraft, Limited.

Porter, Richard William, Ph.D.; Development Engineer, General Electric Co.

Prenzlau, John Herbert, B.S. in M.E.; Management Engineer, Niagara Frontier Div., Bell Aircraft Corp.

Roman, Alfred Isaac, B.S. in M.E.; Engineer, York Research, Inc.

Ross, Irvine Emerson, Jr., M.S. in E.E.; Technical Advisor—Aircraft, National Electric Manufacturers Assoc.

Shue, George Llewellyn, Ph.D.; Development Engineer, Consolidated Vultee Aircraft Corp.

Steinman, Jesse J., M.C.E.; Stress Analyst, Aircraft Development, Fisher Body Detroit Div., General Motors Corp.

Strickland, C. Kenneth, B.S., LL.B.; President & General Manager, The Strickland Aircraft Corp.

Terry, Cyrl Waldie, M.M.E.; Chief Flight Test Engineer, The Ryan Aeronautical Co.

Wedberg, Frank Albert, B.S. in M.E.; Asst. to Director of Engineering, Curtiss-Wright Corp.

Williams, Charles Wilmot, B.S. in M.E.; Project Engineer, Engineering Div., Chrysler Corp.

Transferred to MEMBER Grade

Crow, Lofton De Shong, B.Sc. in Ae.E.; Test Pilot and Contracts Engineering Staff Asst., Airplane Div., Curtiss-Wright Corp.

Haynes, Alex L., B.S. in M.E.; Project Engineer, Aircraft Development Section, Fisher Body Div., General Motors Corp.

Horton, Claude, Principal Aircraft Procurement Supervisor, War Training Service, C.A.A.

Kaganov, Benjamin Jon, B.S. in Ae.E., M.S. in Ae.E.; Chief Structures and Flight Engineer, Eastern Aircraft Div. (Trenton), General Motors Corp.

Liepman, Hans Peter, Dipl. Ing., M.S.; Asst. Prof., Aeronautical Engineering Dept., University of Cincinnati.

Prenovich, Bernard Leo, Chief of Structures, Sikorsky Aircraft Div., United Aircraft Corp.

Elected to Industrial Member Grade

Brown, Gordon Delbert, Director of Market Research & Economic Planning, Douglas Aircraft Co., Inc.

Cargen, Everett Henry, Jr., B.S.; Sales Research Engineer, Wright Aeronautical Corp.

Connor, Kirke White, President and General Manager, Micromatic Hone Corp.

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Cook, Haswell Canfield, Motion Picture Producer, Writer, and Lecturer.

Couchman, Carl Spencer, M.E.; Service Engineer, Republic Aviation Corp.

Hoelzer, Frederick John, Asst. to Coordinator of Training, American Export Airlines, Inc.

Magin, Francis William, President, Square D Company.

Meeker, William Maurice, B.S.; Factory Representative, Lockheed Aircraft Corp.

Phelps, Alva Weaver, Asst. Vice-President, General Motors Corp.

Pulliam, Keeling Gaines, B.M.E.; Lt. Col., Projects Officer, Control Section, Maintenance Div., A.S.C., U.S. Army Air Corps.

Wright, Glenn Ellsworth, Production Engineer, Bechtel, McCone, Parsons Corp.

Elected to Technical Member Grade

Block, Henry David, B.C.E.; Flight Engineer—Experimental, Goodyear Aircraft Corp.

Boley, Bruno Adrian, B. in C.E.; Research Asst., Polytechnic Institute of Brooklyn.

Brooks, Theodore Albert, Quality Instructor of Inspection, Airplane Div., Curtiss-Wright Corp.

Chevalier, Clare Culver, Group Engineer—Design Engineering, Bell Aircraft Corp.

Coronato, Angelo Albert, Transmission Group Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Dunes, Walter Anton, B.S. in M.E.; Jr. Aerodynamicist, Curtiss-Wright Corp.

Guran, John Daniel, C.E.; Liaison Engineer, Goodyear Aircraft Corp.

Haar, Marvin I., B.A.; Asst. Mathematician, Langley Mem. Aero. Lab., N.A.C.A.

Hill, Lloyd E., B.S. in M.E.; Jr. Stress Engineer, Eastern Aircraft Div., General Motors Corp.

Jones, Charles Walker, M.E.; Group Leader (Empennage), Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Juster, Allan, Engineer, Douglas Aircraft Co., Inc.

Keto, George John, B.S.M.E.; Jr. Aerodynamics Engineer, Airplane Div., Curtiss-Wright Corp.

Kendall, Julius, B.S.; Lt., Officer-in-charge, Airframe Accessory Section, Maintenance Div., Bureau of Aeronautics, U.S. Navy.

King, Robert D., B.S. in Ae.E.; Squadron Engineering Officer, Lt., U.S. Army Air Forces.

Kochenburger, Ralph John, M.S.; Asst. Project Engineer, Propeller Div., Curtiss-Wright Corp.

Mabrey, William Taylor, Staff Engineer, Pan American Airways System.

MacKnight, Frank Edward, Degree in Industrial Designing, Design Engineer, Firestone Aircraft Co.

Mayfield, Max James, Professional Engineer—Designer B, El Segundo Div., Douglas Aircraft Co., Inc.

McCarthy, Edward Schenke, B.S. in M.E.; Apprentice Engineer, Pan American Airways System.

McFarlane, Robert Elwood, Flight Sergeant, R.C.A.F.

I. A. S.

National Meetings Schedule

1944–1945

July 27–28, 1944
SUMMER ANNUAL MEETING, LOS ANGELES, CALIFORNIA

September 22, 1944
AIR TRANSPORT MEETING — WASHINGTON, D.C.

November 9–10, 1944
FALL MEETING — DAYTON, OHIO

December 17, 1944
WRIGHT BROTHERS LECTURE — WASHINGTON, D.C.

January, 1945
THIRTEENTH ANNUAL MEETING — NEW YORK

April, 1945
SPRING MEETING — DETROIT, MICHIGAN

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to
The Meetings Committee
Institute of the Aeronautical Sciences
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

Meier, James Edward, C.E.; Lt., Asst. Engineering Officer, U.S. Army Air Forces.

Millson, Robert John, Flying-Officer, Technical Branch, R.A.F.

Rubin, Herman, A.B.; Engineer Aide, Naval Air Experimental Station, U.S. Navy Yard.

Rubin, Irving, B.S. in M.E.; Aero. Engineer, Boeing Aircraft Co.

Slivka, William Reginald, B.S. in M.E.; Jr. Stress Analyst, Eastern Aircraft Div., General Motors Corp.

Smith, Forrest Preston, Jr., Group Leader, Edo Aircraft Corp.

Soraghan, Joseph Cahill, Jr., Group Structural Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Strible, Ferdinand Charles, Jr., Stress Analyst, The Glenn L. Martin Co.

Stuth, Wilfred H., Lt., Aeronautical Maintenance Engineer, U.S. Army Air Forces.

Wagner, Francis Vincent, M.M.E.; Project Structural Engineer, Brewster Aeronautical Corp.

Werner, Milton, B.S. in M.E.; Jr. Mech. Engineer, Flight Research, Aircraft Engine Research Lab., N.A.C.A.

Transferred from Student to Technical Member

Bailey, Joshua Reese, B.S. in Ae.E.

Callaghan, Edmund Ethelbert, B.Ae.E.; Asst. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Carras, Anthony, Lt., U.S. Army Air Forces.

Forsyth, Charles Morris, B.S. in Ae.E.; Aero. Engineer, P-1, Langley Mem. Aero. Lab., N.A.C.A.

Horwitz, Nathan, B.S. in Ae.E.; Engineering Draftsman, Consolidated Vultee Aircraft Corp.

Hoskins, Richard Ireland, Jr., B.S. in M.E.

Johnston, Robert Pelley, B.S. in Ae.E.; Minor Layout Draftsman, Consolidated Vultee Aircraft Corp.

Krop, Philip, B.S. in Ae.E.; Aero. Engineer, P-1, Langley Mem. Aero. Lab., N.A.C.A.

Lindskog, Gordon Wagner, Asst. Division Officer, U.S. Navy.

Martin, Albert James, B.S. in Ae.E.; Aero. Engineer, Grumman Aircraft Engineering Corp.

Myers, Harry S., Jr., B.S. in Ae.E.; Ensign, U.S.N.R.

Negrin, Romulo, B.Ae.E.; Sub-Lt., Aero. Engineer, Mexican Air Force.

Redfield, Marvin, B.Ae.E.; Aerodynamicist, Consolidated Vultee Aircraft Corp.

Rice, James Shannon, B.Ae.E.; Ensign, U.S. Navy.

Rosenberg, Gordon, B.S. in Ae.E.; Advance Naval School.

Triche, Harry Alwain, B.S. in M.E.; U.S. Navy.

Ward, Arnold Carlyle, B.S. in Ae.E.; Engineer, Douglas Aircraft Co., Inc.

Whitaker, Henry Philip, B.S. in Ae.E.; Mathematician, Consolidated Vultee Aircraft Corp.

Elected to Affiliate Grade

Fraser, Walter McLeod, Instrument Technician, Airplane Div., Curtiss-Wright Corp.

Hampton, John Kenneth, Lt. Col.; Area Procurement Officer, Air Corps, U.S. Army Air Forces.

Lewis, Woodrow Phelps, Foreman, Sacramento Air Depot—War Dept.

Van Nice, John Horace, B.A.; Flight Service Engineer (Electrical), Consolidated Vultee Aircraft Corp.

Necrology

Arthur John Brandt, Engineering Consultant to the Chairman of the Board of Consolidated Vultee Aircraft Corporation and a Director of the Corporation, died on May 31. In addition to his connections with Consolidated Vultee, he was President of the A. J. Brandt Company and President and General Manager of the National Machine Tool Company of Cleveland.

Mr. Brandt was a native of Walnut, Kan., where he was born on June 23, 1888. He was a graduate of the Case School of Applied Science in Cleveland. From 1916 to 1920, he was Resident Engineer of E. I. du Pont de Nemours & Company, Inc., and from 1920 to 1928 was Vice-President in charge of operations of the Pontiac Division of General Motors Corporation. In 1928 he founded his own company for management and consulting engineering work. He was credited in a large measure for developing the assembly line for the B-24 Liberator bomber at the San Diego plant of Consolidated Vultee.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Stress Analysts—at least two years' experience on aircraft stress analysis for similar work on plastic aircraft assemblies involving nonwrinkling skin construction. Address inquiries regarding education, experience in detail, draft status and salary requirements to Universal Moulded Products Corporation, Bristol, Va., Attention Dr. R. J. Nebesar.

Aeronautical Engineer—A graduate engineer, specialized in performance and range studies, who is currently up to date with latest developments in flaps, slots, and high lift devices. Position for future development. All inquiries treated confidentially. Applicant must offer a statement of availability. Submit résumé of education, experience and salary requirements to the Development Division, Fairchild Engine and Airplane Corporation, 30 Rockefeller Plaza, New York 20, N.Y.

Aeronautical Engineer—with at least three years' experience on aircraft stress analysis for stress analysis and special project work in the development of aircraft and associated products. Write, advising experience in detail, draft status, and salary requirements. Address inquiries to Vidal Research Corporation, Central Airport, Camden, N.J.

Aircraft Engineers—openings available in progressive Aircraft Company for layout and design engineers to cover Wing, Empennage, Power Plant, Fuselage, Electrical and Radio, Landing Gear, Hydraulics, Equipment, and Controls. Also openings for Tool Designers, Tool Planners, Production Planners, Loftsmen and Aircraft Drawing, and Template Checkers. Those presently employed in essential war work need not apply. Airmail complete detail information regarding education, experience, salaries, former employers, age, family status, citizenship, and draft status, in order that we may be able to evaluate your qualifications from the first letter. Address inquiries Higgins Aircraft Inc., P.O. Box 32, New Orleans 6, La.

Product Designers & Draftsmen—Work on small electromechanical, aeronautical devices. Excellent postwar prospects. Must comply with W.M.C. Address reply to Lear Avia, Inc., Piqua, O., Att: R. J. Biggs.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen not employed in essential war industry or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.

Aeronautical Engineer wanted for promotional work in expanding line of highly specialized equipment for aircraft, also airway and airport control tower equipment. Must have extensive background in aircraft instrumentation, know the pilot's problems and the requirements of the air lines. Good basic knowledge in aerodynamics, physics and electronics necessary. Engineering sales and service experience contacting air lines and aircraft manufacturers desirable. Apply Wallace & Tiernan Products, Inc., Belleville 9, N.J.

Aeronautical Engineers urgently needed by Consolidated Vultee Aircraft Corporation, Fort Worth Division, to execute program of extensive development of large aircraft. Applicant must have technical training and not presently employed in essential war industries. Apply direct to 921 Lamar Street, Fort Worth, Tex.

Aeronautical Engineers—needed by manufacturer of aircraft and aircraft parts in Minneapolis, Minn. Opening available for stress engineer, weight engineer and draftsmen. Applicants must have technical training, experience in the design of metal monocoque aircraft construction, must be draft exempt. Complete information as to education, experience, and salary expected should accompany first letter. Address inquiries to Box 234, Institute of the Aeronautical Sciences.

Senior Mechanical Engineers, Junior Mechanical Engineers, Mechanical Draftsmen needed for new aircraft engine programs by an aircraft-engine company in the eastern area. Aircraft-engine experience preferred but not necessary if mechanical background is satisfactory. Proper clearance with the War Manpower Commission necessary. To arrange for an interview, please send your qualifications to Box 232, Institute of the Aeronautical Sciences.

Engineers—design, aeronautical experience necessary; particular reference to work in hydraulics and structural design; also engineering draftsmen with aeronautical background. Address inquiries to Box 228, Institute of the Aeronautical Sciences.

Draftsmen—Detailers—Checkers—Stress Analysts, wanted by one of the larger aircraft accessories manufacturers. Excellent immediate and postwar opportunities. Plants located in southwestern Ohio. Address inquiries to Box 219, Institute of the Aeronautical Sciences.

Aeronautical and Mechanical Draftsmen—must have general background. **Aeronautical Engineer**—with broad experience in aircraft maintenance or a general background in layout and design. **Mechanical Engineer**—with some experience in both steel and wood construction; also one Mechanical Engineer with some experience in electrical installations. All applicants must be eligible for Civil Service. Location: Florida. Include picture and all pertinent information as to age, education, and experience in first letter. Applicants must have certificate of availability. Address inquiries to Box 216, Institute of the Aeronautical Sciences.

Design Draftsmen—Good opportunity available for designing and project development work. Must be citizen not employed in essential war industry or have proper certificate of availability. Write, giving full particulars including draft status to Box 212, Institute of the Aeronautical Sciences.

Helicopter Project Engineer—No helicopter experience required. Must have extensive record in the successful project management of Army-Navy airplane projects and certificate of availability. Pennsylvania aircraft manufacturer. Address inquiries to Box 235, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Engineer—Graduate, age 30, 4½ years' airplane power plant supervision, layout and design experience. Overseas experience (North Ireland), 9½ months. Available after July 5. Address inquiries to Box 233, Institute of the Aeronautical Sciences.

Director of Quality, Chief Inspector for aircraft construction contact with Army or Navy (Navy preferred), 20 years' aircraft experience, also interested in aircraft maintenance, overhaul, and repair. Address inquiries to Box 230, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B. of Ae. Eng., 35 years old, with teaching experience in Vocational Education and Aviation Maintenance. Desires position in Industry in East. Most recent experience doing technical writing and supervising of technical training with the Army Air Forces Technical School. Address inquiries to Box 224, Institute of the Aeronautical Sciences.

Aeronautical Engineer—15 years' experience, manufacturing military and commercial aircraft, air-line and military maintenance, development and research. Some experience with purchasing, plant layouts, teaching and plastics. Desires position with postwar future. Address inquiries to Box 221, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer—20 years' broad experience in all phases of military and commercial aircraft. Desires responsible position as development, liaison, or design project engineer with eastern company with postwar future. Certificate of availability after April 1. Address inquiries to Box 217, Institute of the Aeronautical Sciences.

Engineer, B.S. (C.E.) Univ. of Colo., 1938, research minded, desires connection in project engineering in air transport field or with progressive aircraft manufacturer. Two years' experience in project stress analysis and liaison stress work in aircraft manufacture, two years' investigation work for a state agency, one year with a leading structural design company. Address inquiries to Box 215, Institute of the Aeronautical Sciences.

Engineer, Graduate, Aeronautical, and commercial pilot, over 5 years' aircraft experience, including service as design, flight test, and project engineer, demonstration and check pilot, desires responsible position furthering use and expansion of this experience. Address inquiries to Box 211, Institute of the Aeronautical Sciences.

Consultant Aeronautical Engineer recently discharged Army Air Forces, formerly executive Chief Engineer, desires additional consultant work under contract. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

(*Continued from page 145*)

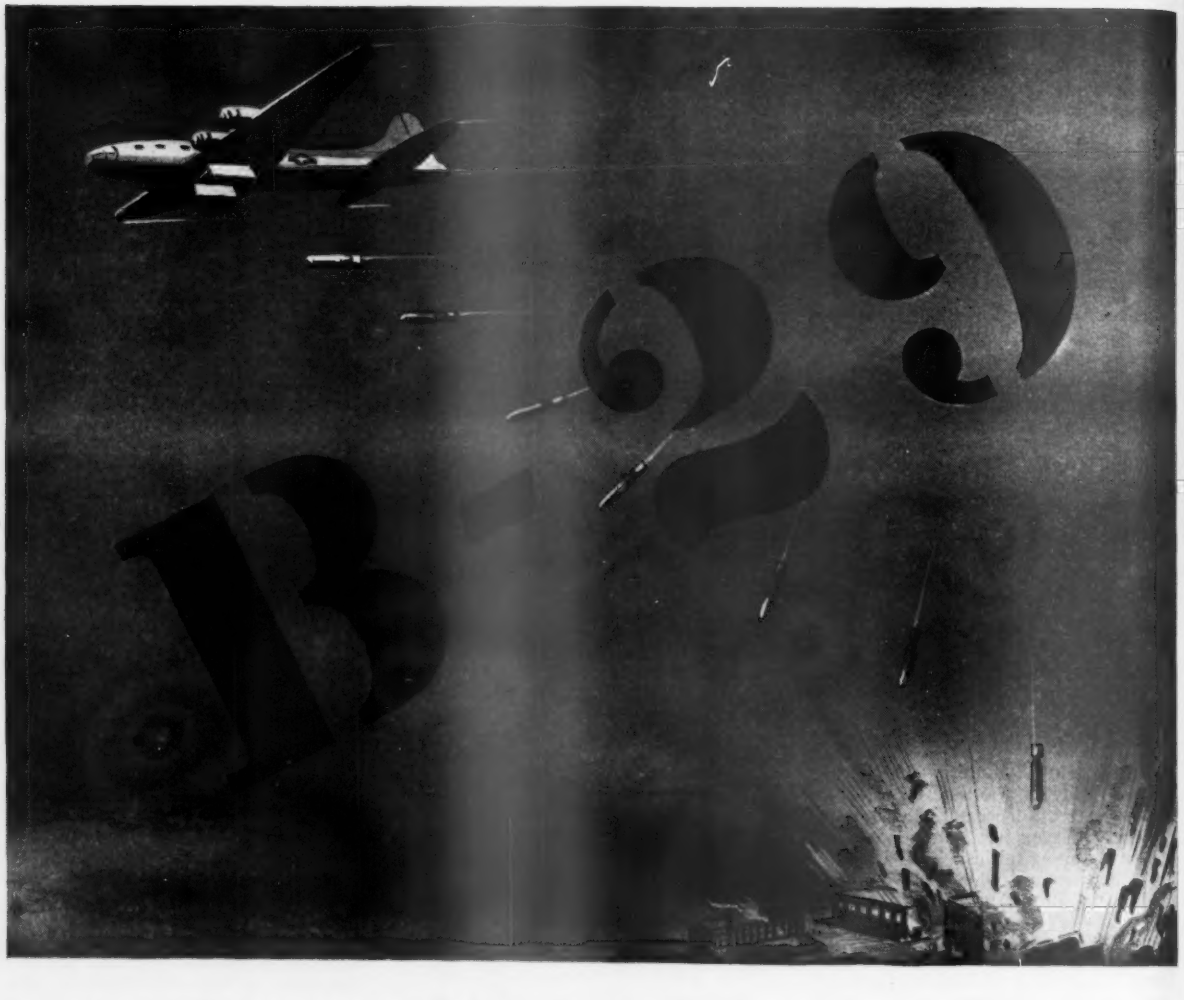
Employee Suggestion Plan. Five production suggestions that have earned awards for their originators are: (1) A special stepped boring bar that eliminates two cuts in the machining of the tail wheel housing and also reduces some of the gauging and checking operations; (2) a modification of the lathe-holding fixture used in the machining of the hydraulic hand-pump body, which eliminates the grinding operation; (3) a tool for removal of the threaded fittings from the manual outlet of the fire-extinguisher valve; (4) a form of fly cutter, operated by a crank handle, for enlarging the opening in the fire wall through which passes the gas line from the tanks in the center section to the wabble pump; and (5) the use of stops on the mandrel of the Parker Tube Bender to simplify tube bending. *Noorduyn Tale-Spin,* May, 1944.

Girl Worker Wins Suggestion Award. The devising of a support by which templates can be tied to the Weideman punch press won a suggestion award at Consolidated Vultee's Miami Division. *Convair News,* May 12, 1944.

$3,692 Is Paid to 310 Suggestions Winners, with Single 'A' Award. An "A"-award winner at Douglas Aircraft was a suggestion for thread maskers to assist in painting the insides of engine-mount tubes. *Douglas Oklahoma City Airview News,* May 6, 1944.

Suggestions Hit All-Time High for Plant. Production suggestions submitted by Douglas Aircraft employees include: (1) A combined die consisting of a standard hat section, channel section, "Z"-angle, and bulb angle joggle, which saves time and material; (2) an attachment that trims the bomb bay door tracks of a bomber in one-eighth the time formerly needed for the task; (3) a height-gauge attachment that reaches inside surfaces not accessible to ordinary precision instruments. *Douglas Tulsa Airview News,* May 12, 1944.

Win Grand Award of $150 in Bonds. A design for a locking device to hold the nose section of a glider in the opened position won the prize in a 6-month contest conducted at Commonwealth Aircraft Inc. The device is reported to make the assembly safer to operate, to enable the part to be made more quickly, to save material, and to reduce the percentage of part rejections. *The Common-Ader,* May 11, 1944.



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Suggestion Awards Merited by Six Winners. The suggestions committee of Interstate Aircraft & Engineering Corporation gave awards for the following ideas: (1) Use of a $2^1/_2$-in. rubber mushroom sanding disc in a $^1/_2$-in. drill motor to scarf out patches in wood skins. This suggestion is said to result in a saving of time and material over the former method of using a chisel and pocket knife. (2) A method to increase the width or length of a prefabricated plywood skin eliminates extensive rework to make these usable. (3) A drill rod for holding the Camlocks while drilling holes in skins. (4) Method of accurately locating and centering pilot holes in relation to nacelle fairings, etc. *Interstate-ments,* May 4, 1944.

256 Ideas Submitted by Employees Here Bring Them $4,822 in Suggestion Awards. Among the winning suggestions in a group for which $4,822 was paid in awards were: (1) Additional awards resulting from rechecks of suggestions regarding the making of sub plates for large minster punch presses, permitting the use of small dies in these presses and relieving the congested work schedules for smaller presses. (2) An additional award for a method of cutting small rudder hooks from extrusion material, shifting the work to an automatic operation on screw machines. (3) Adjustable line-transfer blocks for use in making templates. *Convair News,* May 19, 1944.

Suggestions Win Awards. Awards were made by Globe Aircraft Corporation for the following employees' suggestions: (1) device for straightening tubes; (2) planer jigs for nacelle-reinforcing blocks; (3) quicker method of fairing gas tanks. *The Globe Beam,* April, 1944.

The Very Idea! The following ideas led to improved production and awards for their originators: (1) device for reducing rewelds on connecting-tube parts; (2) a double-plunger squeezer device for leading edges of airplane wings; (3) the use of a specially designed holder and a shell-end mill cutter in the boring of flanges. *Ryan Flying Reporter,* May 19, 1944.

J. D. Simmons New Topnotcher: $173 in Awards. The "topnotcher" award at Consolidated Vultee's Nashville Division for the week ending May 19 was for a suggestion that eliminated two handlings of raw stock for shipment to subcontractors. *The Consolidated Vultee Volunteer,* May 19, 1944.

Suggestions Pay. Award-winning suggestions at the Aero Division of the Minneapolis-Honeywell Regulator Company were: (1) a more sensitive gram gauge for the final assembly and inspection of certain parts; (2) method of burring gears by grinding instead of filing each tooth. *Aero,* April, 1944.

(*Continued from page 32*)

spool and shaft intersect at a slight angle at the center of the spool. The outside cylindrical face of the spool is helically channeled—i.e., externally rifled. A second outer spool, C, similarly eccentrically bored, and, with the bore helically channeled or rifled, opposite hand to the rifling on the inner spool, B, surrounds the inner spool, B.

The two spools are engaged for the lower portion of their length by a liner sleeve, D, which is helically channeled or rifled, both internally and externally, to mesh with the helical rifling on the two spools, B and C. Except for the engagement effected by the sleeve, D, spools B and C are free to turn relative to each other but are collared at their upper ends to prevent relative longitudinal movement. Sliding the sleeve, D, up or down while engaged with the spools B and C turns the two spools relative to each other and enables any required inclination of the outer spool, C, relative to the shaft, A, to be effected. Mechanical linkage aligned to the shaft, A, permits the sleeve, D, to be forced up or down while the shaft and spools remain engaged and are rotating together. This linkage is not shown.

An upward extension of spool, C, constitutes the precessing axle about which the rotor spins. An external ring gear, E, keyed to the spool, C, drives a ring of spur gears, F, fixed to the bearing block, G. An internal ring gear, H, fixed to the hub, J, is driven by the spur gears, F. The bearing block, G, is mounted inside the top of the mast on heavy gimbals, permitting this bearing block to swing freely to any inclination with the vertical but fixing the bearing block against rotation.

Functioning of the Mechanism

The functioning of the mechanism can be understood by inspection of Fig. 3. Rotation of the drive shaft, A, precesses the axle about which the hub, J, is oppositely rotated through the gears, E, F, and H. The inclination of the precessing axle relative to the axis of the drive shaft can be adjusted at will by forcing the sleeve, D, up or down. Micrometric positioning of this sleeve is provided for by linkage operated from within the craft. The gimbal-mounted bearing block, G, accommodates itself to precession of the rotor axle, as well as to swing of the drive shaft to obtain horizontal component of lift.

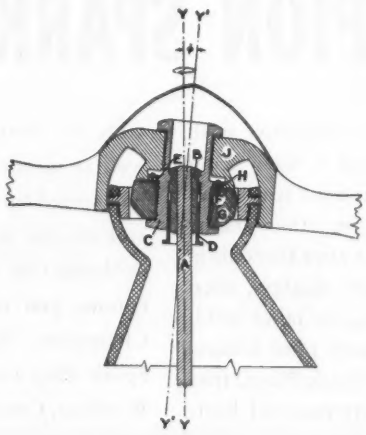

FIG. 3.

The axle is shown symmetrically aligned with the body of the outer spool of which it is a part, and the rotor blades are shown mounted on the hub so that the plane of the rotor disc intersects the center of the gimbal mounting. This locates axle and rotor in the neutral or index position, which makes no provision for countering unbalanced residual forces. Once the constants of a specific problem have been determined, the eccentric misalignment of axle and outer spool and the position of the plane of the rotor disc relative to the center of gimbals can be derived. These eccentricities are a responsibility of final design.

DIFFICULTIES AND ADVANTAGES

Forced precession of the spinning rotor would indeed introduce issues of vibration control to a problem already seriously embarrassed by forced vibrations. It would also, however, help to gather the application of the principal forced vibrations at a single point, the rotor hub, and this would seem to be an obviously desirable first step in any rational attempt to resolve the problem of vibrations.

It would be naive to suppose that forcibly precessing the spinning rotor would not greatly complicate many other problems of design in addition to vibration control. It would be beyond the scope of this article even to try to enumerate these difficulties, but it is within the scope of any discussion of the helicopter to caution that neutralizing reaction torque is only one of many design problems, none of which may be conclusively dealt with apart from all the others.

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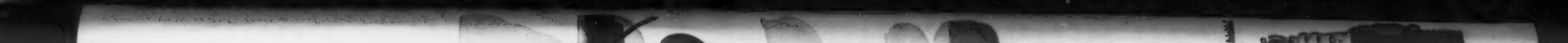
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